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DISSERTATIONS
ON
INFLAMMATION.

VOLUME I.

CONTAINING,

PRELIMINARY DISSERT.—ON SOME OF THE LAWS OF
THE ANIMAL ECONOMY.

DISSERT. II.—ON THE HISTORY, CAUSES, AND CONSEQUENCES OF SIMPLE INFLAMMATION.

BY JOHN BURNS,
SURGEON IN GLASGOW.

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DISSEMINATION

ON

INFLAMMATION

VOLUME I

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ORIGINAL ARTICLES

BY JOHN BURNES

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1800

TO
ANDREW DUNCAN, M. D.

PROFESSOR OF THE INSTITUTIONS OF MEDICINE

IN THE UNIVERSITY OF EDINBURGH ;

THE FOLLOWING

DISSERTATIONS

ARE INSCRIBED,

AS A TESTIMONY OF ESTEEM,

AND OF THAT RESPECT

**WHICH IS DUE TO HIS PROFESSIONAL LEARNING
AND ABILITIES,**

BY HIS SINCERE FRIEND,

AND HUMBLE SERVANT,

JOHN BURNS.

Glasgow, May 10.
1800.

TO
ANDREW DUNCAN, M.D.

PROFESSOR OF THE INSTITUTIONS OF MEDICINE

IN THE UNIVERSITY OF EDINBURGH;

THE FOLLOWING

DISSERTATIONS

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AS A TESTIMONY OF TALENT

AND OF THAT RESPECT

WHICH IS DUE TO HIS PROFESSIONAL LEARNING

AND ABILITIES

BY HIS SINCERE FRIEND,

AND HUMBLE SERVANT,

JOHN LINDSAY

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P R E F A C E.

THE foundation on which medical reasonings are built, is a knowledge of the laws and operations of the living principle; but as our acquaintance with these is exceedingly imperfect, the opinions which are formed from this must be fluctuating, and frequently very uncertain.

WHEN physic first became a science, the doctrines of its teachers were, of necessity, rude and chimerical; and even after it had been studied for many hundred years, it continued to be obscured

by a multitude of idle theories. As these were founded not on facts, but on what the imagination of their inventors believed to be probable, it is not wonderful, that each succeeding teacher should change and modify the doctrines of his predecessor : But even these changes, however highly they might be valued by the school which effected them, embraced only a very small extent. The more trifling parts of the system alone suffered an alteration ; and the great outlines of former opinion seemed to be beheld, for ages, as boundaries marked out by a Superior Being to the human understanding, and marked with the characters, Hitherto shalt thou come, but no farther. For by far the longest period of medical history, we find these outlines to be drawn on a wrong foundation ; the principles of pathology being taken from the properties and conditions of the dif-

ferent fluids of the body. In the first ages of knowledge, the mind was impressed with material objects alone, and was able to reason only concerning objects of sense. That the grosser part of matter must have some more subtle power acting on it, in order to make it perform its operations, appeared evident to all; but of this they could form no idea, otherwise than by supposing an intelligence which, by its active qualities, could operate just as man moves and regulates the machines, which he makes. The nature of this intelligence they also endeavoured to explain; but, by having their minds tied down wholly to material objects, the ancient philosophers could form no conception of a principle purely spiritual. They, therefore, chose the most subtle matter with which they were acquainted; and believed heat, or a principle to which they gave this appellation, to be

the soul of the universe, from which emanations went forth to enliven the individuals of the creation. Such being the doctrines of the philosophers, medical reasonings came naturally to be founded on the properties and changes of the material part of the frame, which changes were again referred to the operation of an intelligent and sentient principle.

It was the discoveries of the immortal Newton, which first paved the way for the real improvement of medical science; for he, in one great branch of natural knowledge, banished completely the mechanical interference of intelligent agents, and taught the existence of a principle purely immaterial, and which, without any wisdom or volition, could act by being acted on. The mind now came gradually to be weaned from reasonings totally material and mechanical; and phy-

ficians, by degrees, began to attribute the operations of the animal frame, not to a thinking power, which presided with wisdom over the system, but to a principle, which was implanted in man at his creation, and which, through the medium of the nerves, in which it was supposed to be lodged, carried on his functions, according to a rule established from the beginning, without possessing either knowledge or judgment. It required, however, a step farther to banish the doctrines of the changes of the fluids, and the belief in these as the cause of disease; and so strongly have these notions taken hold of the mind, that they are not yet altogether given up.

AN examination into the properties and source of this living principle, or nervous energy, as it has been called, forms the subject of the Preliminary Dis-

sertation, in which I have endeavoured to explain some of the principal laws and operations of the animal economy. The subsequent Dissertations contain an inquiry into the nature and mode of treatment of some of the different species of inflammation, founded upon those laws or properties of the living principle. These are part of a course of lectures which I read upon surgery, three years ago, in the Royal Infirmary in Glasgow.

I OFFER them now to the Public with much diffidence; but, at the same time, with a sincere hope that they may be useful to others, in considering the same subjects, which are of the very first importance to every surgeon. If, in any part, I shall appear to be unnecessarily tedious, I beg it to be remembered, that some of these positions differ from those

commonly maintained, and, therefore, require to be more fully illustrated. I do not write to surgeons who already understand these subjects, but to students, who as yet have their knowledge to acquire, and to whom many illustrations are useful, which to others, who know more, may appear to be unnecessary.

ERRATA.

The Reader is requested, with his Pen, to correct the following Errors, and to supply the Omissions which have inadvertently taken place.

VOL. I.

P. 22. l. 4. *For cerebellum, read cerebrum.*

P. 109. l. 7. *For association, read affociation of distant parts.*

P. 109. Before the last line, the following paragraph ought to have been inserted, but was omitted.

THE sympathy of association may be divided into the interrupted, or the sympathia confociationis interrupta, in which distant parts are affected, whilst sound parts intervene betwixt them; and the spreading, or the sympathia confociati-

onis serpens, in which the action spreads inch by inch with more or less rapidity. The interrupted sympathy generally is induced quickly, and, in many cases, does not last long; the spreading takes place more gradually, and is, in every instance, of considerable duration. It may also come to affect parts which were formerly influenced by the interrupted sympathy, and may overcome the natural tendency of particular parts to exhibit the sympathy of equilibrium. The interrupted sympathy is sometimes the forerunner of a general action, the brain or stomach sympathizing before any other part of the system.

P. 138. l. 2. At the word *lassitude*, there ought to be a reference to the following note :

This proceeds, in a great measure, from the diminution of the action of the muscles. In many instances, this diminution of natural action is productive of a very painful sensation, which is felt in most of the muscles, and which causes the patient to complain of pain in his back and in his bones, whilst in reality it is the muscles alone which are pained. Sometimes this diminution of natural action is

productive of spasmodic affections. I have known fevers ushered in by convulsions of the whole muscles of the body, especially of the spine, and these continued during the period of formation.

P. 180. Note. *For Lamentii, read Laurentii.*

P. 276. l. 4. *For whilst, read whether.*

P. 362. l. 10. At the word *mind*, there ought to be a reference to the following note :

In some rare instances, the change of action does not produce sensation, or at least the sensation does not amount to pain. Dissection proves, that in certain cases, inflammation has existed, and has produced suppuration, without giving any very painful sensation to the patient.

P. 443. l. 10. *For of, read off.*

P. 449. l. 4. *For prepared, read proposed.*

VOL. II.

P. 112. l. 6. *For cold, read coldness.*

DISSERTATIONS
ON
INFLAMMATION.

PRELIMINARY DISSERTATION
ON SOME OF THE
L A W S
OF THE
ANIMAL ECONOMY.

Introduction.

NATURAL historians have divided the objects of their examinations into three great classes; which have been called the kingdoms of nature; the animal, the vegetable, and the mineral.

AMONGST all the different individuals of these divisions, an organised form regularly prevails. A stone or a salt assumes uniformly an appearance which continues always the same in similar species. The vast rocks of Basaltes, which stand as so many monuments of the dreadful cause which produced them, consist of large pillars, having five sides of unequal dimensions. Silicious crystals exhibit the form of hexagonal pyramids, whilst the zeolite assumes the figure of a beautiful star, and the amianthus that of regular and parallel fibres.

THE vegetable has likewise its appropriate construction, which, as in the other kingdoms, continues always the same; but in this respect it differs from the mineral, that to a regular figure there are conjoined organic vessels to maintain and increase that form, according to the uni-

form action of a certain principle which they possess, and which has been called life. If the plant be cut through level with the earth, we soon find that the loss is supplied, and new sprouts formed, which produce leaves, flowers, and fruit, exactly similar to those which were cut down. If we apply a stimulus to it, a particular effect is produced, according to the nature of the application, or of the part acted on. If it be light, the organs of motion become affected, and the leaves turn toward the ray, or the flower-leaves open to admit the light and air to the parts of fructification. If heat be applied to the plant, in a slow and regular manner, it supports and assists the exercise of its functions, and consequently contributes to its strength and increase. But if it be applied hastily, and to a great degree, it disorders the action of that power which preserves the plant, and either dis-

ease or death is the result. The laws and operations of this power are few and simple; but when we ascend to the animal creation, we find, that not only the structure is more complex, but also the modes of action are much more numerous.

THE individuals of the last class have promiscuously received the name of dead matter, because, when compared with the other classes, they appeared to be inanimate. But by a more accurate examination, we shall find, that there is in reality no individual whatever in any of the kingdoms or classes of nature which can be called inert, or truly dead. For, from the largest masses of matter down to the most minute corpuscles, we distinctly perceive the operation of an active and immaterial principle*.

* The particular nature of this principle, as we shall afterwards see, never can be ascertained. We are, however,

THIS principle has received different names, according as it manifests itself. The power which supports the functions (if I may use the expression), and regulates the motions and actions of the different parts of the universe, has been called gravitation; whilst the property which makes one particle unite with another, and which modifies the form, and produces the increase of the smaller bo-

dy, is called cohesion. I am sufficiently assured, by the phenomena which we observe, that in all the classes of nature such a principle does exist. But the relation which the enlivening or vital powers of one class bears to that of another, cannot yet, if ever, be determined. Whether the same principle only exists in different degrees of perfection in these classes, or whether its nature be essentially different in each, will admit of much discussion. In this paper, however, I can only give a general statement of the idea which I annex to the principle of life, and afterwards mention, in so far as will be necessary for understanding the following Dissertations on Inflammation, some of the operations and qualities of the living principle in man.

dies, has received the name of corpuscular attraction. The principle, again, which regulates the intestine changes, and determines the combinations and specific states of existence in matter, has been denominated elective, or chemical attraction.

How matter, which by itself, and viewed abstractedly, must be considered as inert and dead, should be capable of combining with this active and immaterial power, it is impossible to say. But having from the creation perceived this union, we find it to be now impracticable to form a conception of matter unconnected with this property.

WITHOUT this enlivening principle, all nature must be dead; and matter deprived of it must either cease to exist, or exist in a way which we cannot possibly

comprehend. The union of the whole universe must be dissolved, and the beautiful dependence of one part on the rest for ever destroyed. We know, and are taught to believe, that the Great Being who formerly sent forth this active vital power, and bade the worlds live, will one day recal his gift. Matter shall then cease altogether to be, or shall return to that unknown chaotic state which poets have imagined, and vainly attempted to describe *. The particular laws and operations of attraction, or the life of matter, belong for investigation to the natural philosopher; and therefore it will here only be proper to remark, that I consider

* "Ante, mare et tellus, et, quod tegit omnia, cælum,

"Unus erat toto naturæ vultus in orbe, s. III. C. V. V. V.

"Quem dixere chaos; rudis indigestaque moles;

"Nec quicquam, nisi pondus iners; congestaque eodem

"Non bene junctarum discordia semina rerum."

OVID.

animals, vegetables, and what is called inanimate matter, as all possessing an immaterial principle, differing greatly indeed in its nature and effects in these different classes, but still deserving, in all of them, the name of life, being of equal value to each, and absolutely requisite for their preservation.

THIS power, we have seen, is exceedingly simple in common matter; but when we mount to the next class, that of vegetables, we find a much greater degree of perfection in the life, and much more complicated actions. We have not only the same properties which are possessed by matter, but also additional and very surprising powers. We find them always in a progressive state of growth or decay, endowed with the property of changing foreign matter into a peculiar fluid, which is continually circulated

through their vessels, and converted into a great variety of products. They are farther distinguished, by having within themselves the powers of motion, and of multiplying their species to an endless degree. We then find, that vegetables possess not only the principles proper to matter, but also a life peculiar to themselves, and which, I may say, is built upon the former; for without attraction there can be neither growth nor organization.

WHEN we ascend to animals, we find them possessed of a third species of life, built upon the other two. In this class, besides attraction, or the preserving and active principle of matter, we find reproduction, and the other properties of vegetable life; but these properties are exhibited with a different modification, and are united with others, which of them-

• selves would, independent of the presence of mind, distinguish them from vegetables.

• We have, then, in the three classes of nature, three different species of life, each more perfect than the other, and increasing gradually in their delicacy and intricacy. The most simple, or that of matter, is the most permanent, and on it the other two are built. I do not, however, mean from this to say, that attraction*, or the vital principle of matter, acts in the higher classes merely as attraction; or, in other words, that it remains unchanged in its properties. On the contrary, a very great alteration takes place; and, although it still possesses the quality ex-

* This term is used sometimes for the cause and sometimes for the effect; but the sense will always show how it is to be understood.

pressed by the word attraction, making the parts adhere together, it yet is so far changed and perfected, as to exhibit many other phenomena and new actions, of which, before this elevation, it was incapable. It is rendered not only more perfect, in this respect, of gaining new properties, but even its original quality of producing attraction is much improved; for a living muscle will bear a greater weight, without laceration, than one newly dead, or one called, in common language, dead; which proves, that the vital principle, in animals, has a greater power of producing the effect called attraction, than the vital principle of common matter.

THE three classes run imperceptibly into each other; and thus we have a complete chain of existence established, from the most simple to the most com-

plicated body. Those species of amianthus, which are called mountain cork, although minerals, yet resemble vegetables so strongly, that they link the classes together; whilst the coralines, although animals, resemble both minerals and vegetables. The fungi, though plants, consist of the same principles with animals. Some of the fuci resemble hair, and other cartilage; whilst the sponge, although an animal, grows like a vegetable. Not only the external and chemical qualities, but also the vital principle, and its phenomena, form a regular gradation in the different classes. Even in a single individual of the two higher classes, we perceive the gradual elevation of one species of life into another. This change uniformly begins in the fluid part of the individual. In the plant, the first change produced on common matter, or the aliment, is its conversion into vegetable

juices, which exhibit certain vital phenomena, different from common fluid matter : afterwards organisation is added, in which the vegetable life is exhibited with most perfection. In animals, again, there is a greater gradation, and more complicated change, before animal life be imparted in its greatest perfection. The food is first converted into chyle, which has a lower species of life than the blood, which again is more imperfect in its vitality than the organised parts. The living principle of the blood differs, both in degree and kind, from that which belongs peculiarly to the animal ; but these two are connected, and react on each other.

No substance or piece of matter, whether simple or compound, has of itself a tendency to decomposition, or change of state. For effecting this, the principle of

attraction must be acted on by the addition of other substances, and then a new condition will take place. This is the foundation of chemistry, which is a science wholly built on the effects of attraction. Some have attempted to explain the changes or diseases of living animals by the same laws; but this method cannot be admitted, until it be proved, that their life does not give them properties different from common matter, and make them subject to another set of laws. When they are deprived of this life, then they become liable to the habitudes of matter, and may, by the agency of other substances, be decomposed, and differently combined; but, until their specific life be lost, they bid defiance to such changes; and, therefore, the system of pathology which has been built upon it must be false.

LIFE is a principle which we can only detect and judge of by its operations or actions; and, when these are not exhibited, we are apt, though sometimes erroneously, to conclude, that the body is dead. The leading property of life, is to communicate a preservative power to every individual with which it is connected. This is sometimes effected by very evident and intricate actions; but, at other times, is exerted without any sensible operation. The crystal resists, to a certain degree, mechanical impressions, which would destroy its form. The blood when newly drawn, the sap of vegetables, the living egg, resist cold, by an imperceptible operation, to a much greater degree, when alive, than after their peculiar life departs. They resist all the efforts of chemical agents which act on common matter; nor is it possible to decompose or injure them in this way,

until they lose their specific life, and descend in the scale of existence. This simple preservative power is a discriminating mark of the presence of life; but we cannot detect it until we apply destroying causes: It is the uniform and universal effect of the combination of life with any substance, whatever its nature or structure may be: It is the essential characteristic of life, which it must show whenever it is present. But, when we find vital power united with a certain organisation*, then more varied phenomena take place; and these are called actions of the vital principle†. In the

* I am only here considering animal life, without any connection with an intelligent principle or soul, which is quite a different thing from vitality.

† Every operation of the vital energy is called an *action*, and whatever agent excites this action is called a *stimulus*. The aptitude of the system to be acted on has been expressed by the term *irritability*.

plant, the bud expands, the stem shoots up, the food is absorbed, digested, and circulated; air is thrown out, and particular secretions take place. In the animal, these actions are still more evident, but more intricate, and infinitely more varied. They are the support of our health, and the source of all our disease.

In the two first classes, the enlivening principle seems to be equally united with and dependent on every part; but in animals, to whom I will now confine my attention, the principle which performs these actions is more directly connected with certain organised portions of the body, called brain and nerves, which supply every part, though so minutely, that we often cannot trace their course.

Of the Brain and Nerves,

THE brain* is a soft globular substance contained within the cranium, of

* Were we to proceed regularly to investigate the various phenomena of animal life, we would naturally begin by examining the composition and structure of the different parts of the body. By this examination, we should become acquainted with some fundamental facts, but should still be in the dark with regard to that principle which animates the whole, and enables the various functions to be carried on. An inquiry into the general laws of this energy, which is found to reside in the brain and nervous system, would, therefore, naturally become the second object of our attention. Being acquainted with these, we would next examine the particular functions of man, and the operation of the nervous energy in supporting them. The gradual growth and increase of the animal, the deposition of new matter, and the absorption of the old, would be the first subject of consideration in this part of the examination, and would naturally involve an inquiry into the process of digestion, and the formation of the blood, with its qualities

a dusky colour without, but white in the centre. It is from this white or medullary portion, that we find all those elongations arising, which have been called nerves, and which are just portions of the brain diffused over the body, and exerting there the peculiar properties of the system to which they belong.

and uses. The powers of motion, the influence of the mind, and the history of the different senses and various functions of man, would conclude this part of the inquiry. Having become acquainted with the healthy condition of the system, and the causes which maintain it, we would apply this knowledge to the investigation of the different derangements, or diseased actions of our body, and their cure.

Such might be a proper plan for examining regularly the economy and diseases of an animal; but this would be greatly too extensive for the present purpose. It must here be taken for granted, that the student is acquainted with the structure of the body, and with its different functions, by which he will be able to understand the following general observations on the properties of the living principle, and apply the doctrines more particularly himself.

THESE nerves possess different qualities, according to the portion of the brain from which they arise, and the organism of the part to which they go. Those which go out first, arising from the mammillary processes, and which are called olfactory nerves, are the source of the sense of smelling. The second pair, arising from a particular protuberance, or little brain, called the optic bed, give the important sense of seeing; and, in order to connect those two cerviculae, or beds, we find their elongations joined, before they proceed out of the skull. The third, the fourth, the first branch of the fifth, and the sixth pair of nerves, all arise from the cerebrum, and are distributed on the different parts of the eye, serving chiefly for the purposes of motion. The soft portion of the seventh pair arises from the fourth ventricle, and constitutes the auditory nerve. None of

these nerves support the vital functions; they are all destined either for the organs of sense, or the simple parts about the head.

THE nerves which serve for carrying on the vital functions, all arise either from the medulla oblongata, or spinal marrow. I have seldom, in dissections, found derangements of those parts of the brain, but have often observed very great disease in the cerebrum. In one case, the cerebrum was hard and schirrus, but the cerebellum was found and healthy. This man died comatose, after being long tormented with violent head-aches. In another instance, although the lateral ventricles were so much distended with water, that the hemispheres of the brain were converted into little else than two bladders full of fluid, yet the child was sensible nearly to the time of death.

B

which was produced more by the pressure on the cerebellum, which was not diseased, than by the derangement of the ~~cerebrum~~ cerebellum. In numberless instances, we find the skull beat in upon the cerebrum, or foreign bodies lodged in its substance, or abscesses formed in consequence of blows and falls; and still the patient surviving all the injury *. The physiologist has even removed this part of the brain altogether, in birds and other animals; without death being oc-

* I do not mean to maintain, that wounds of the cerebrum are not attended with great danger. I only wish to prove, that they are by no means so fatal as those of the cerebellum; and, consequently, that the cerebrum is not so immediately necessary to the continuance of life. Spindler, and others, report instances of people walking about with part of the cerebrum gangrenous. Many instances of recovery from severe injuries done to this part, are mentioned in the Memoirs of the Academy of Surgery; and every practical surgeon must have observed, how long a patient often survives the most terrible accidents of the head.

casioned; the senses alone were destroyed. But it is equally well attested, that the cerebellum cannot be injured with the same impunity; for, from the history of those who are killed by blows on the head, and by experiments upon brutes, we find, that, in very few instances, does the animal survive, if this part of the brain be injured *.

We shall next find, that the cerebellum, comprehending its production, the medulla oblongata †, joined by a few

* Although Zinn, Fallopius, Vessingius, and others, consider wounds of the cerebellum as curable, and have cured individuals who were supposed to have this part of the brain injured; and although the illustrious Baron Haller mentions, that he had once seen the cerebellum scirrhus; yet the observation of Bahnius, and others, who have wrote expressly on the subject, that these wounds are almost inevitably fatal, cannot be considered as invalidated by those solitary instances of recovery.

† The medulla oblongata is just a part of the cerebel-

branches from the cerebrum, is expanded or diffused over the whole body. It passes out of the skull, and seeks defence in the vertebral canal, from whence it sends out elongations to all the different parts of the body, which, with those which pass out from it in the skull, support the existence of the animal.

THESE elongations *, or nerves, possess

lum, and is of the same importance to the living system. We see it supporting life in insects, who are without a brain, and in acéphalous monsters. Wounds of it are fatal and dangerous, in proportion as they are near the head; or, in other words, according to the value of the nerves which originate beneath them.

* Aristotle believed, that the nerves originated from the heart; and his successors taught, that the blood-vessels which proceeded from the heart, were converted, in the brain, into nerves. It is on this account, says Van Horn, that, in anger, the blood boils, and the eyes flash with fire.

a degree of energy, or vital power; in themselves, independent of what they receive from the brain as their source. 13 They are neither more nor less than continuations of the brain, possessing the same power, and endowed with a similar quality. It would, indeed, from reflection, independent of experiments, be reasonable to conclude, that the nervous energy must be diffused over all the body, although it resides in a greater proportion in the brain, from whence it is sent to support the other parts of the system. In general, the quantity of energy in a nerve is proportioned to its size; it is greatest in the brain, and less in all the elongations, in a degree correspondent to their magnitude*. The small nerves

* We must carefully distinguish betwixt energy and action, which do not always correspond. The brain, which most likely contains the greatest quantity of energy, con-

have a dependence upon the great, and these again upon the brain: An universal connection is thus established, no one part of the body being of itself sufficient for living*.

THE delicacy of the nervous system is proportioned to the perfection of the animal; and, therefore, it is chiefly by experiments on the individuals of the lower

considered absolutely, exhibits less action than many small nerves; for I do not consider the operations of the mind as an action of the nervous energy in the brain. Mind and nervous energy are totally different; and, once for all, I beg to mention, that I consider the soul or spirit as distinct, and altogether out of the present question concerning vital power, and its actions.

* Although the inherent quantity of energy appears to correspond to the quantity of nervous medulla, yet the action does not, being greatest in the extremities, or rather almost entirely confined to the extremities, which draw their energy from the trunks. These seem to secrete the power, whilst the extremities expend it.

ranks, that this doctrine is to be confirmed. At the same time, some assistance may be derived from what we occasionally observe in the more perfect animals. We find, for instance, that children have been known to grow and live in the womb without any brain, receiving their vital energy from nerves alone; which proves, that a brain is by no means essential to the mere presence of vitality in an animal. On the other hand, we observe, that particular nerves may lose their energy, although the brain remains sound, as we see exemplified in paraplegia and partial palsy. At other times, we find both the brain and the nerve sound, but the connection subsisting betwixt them destroyed; in which case the nerve has only its own inherent energy, and derives no assistance from the brain, or parts above. This is daily seen in curvature

of the spine *. The doctrine may also be confirmed, by the case of a gentleman, who was paralytic from the head downward, but the heart and bowels continued their action. Here the spinal marrow only was diseased; and that portion of the brain which gave off the intercostal and sympathetic nerves, as well as those nerves themselves, was healthy. But it is most beautifully proved, by the well-known experiments of applying zinc and silver to the nerve of an amputated limb, by which we produce contractions of the muscles, and make the apparently

* It is necessary, however, that this interruption take place gradually, in order to accustom the nerve to exert itself, if I may use the expression, independent of the brain: For, if we cut the nerve suddenly, we find, that the difference betwixt the energy inherent in the nerve, and that which it was wont to receive from the brain, is so great, that the parts cannot exist: The change is too great and too sudden.

dead member move upon the table. It
 has been long known, that if we tie a
 ligature upon the phrenic nerve of a dog,
 the motion of the diaphragm ceases; but
 if we stimulate the nerve below the com-
 pressed spot, by stripping it either up-
 ward or downward between our fingers,
 the contraction of the diaphragm, for a
 time, returns. By experiments upon the
 amphibious and reptile tribe, the doc-
 trine is ascertained to be true beyond all
 dispute. It is well known, that a frog
 will live, for a couple of days, after his
 head is cut off; that he will jump about,
 and will even, if we may credit the Abbe
 Spallanzani, return to the embraces of
 his mistress, if the decapitation has taken
 place during the payment of his ad-
 dresses. It is also known, that if we di-
 vide the spinal marrow, the crural nerves
 being no longer assisted by the parts a-
 bove, become weakened, having only

their own energy, and the limb is palsied; but still there is energy sufficient to continue the circulation; and "the bones, if fractured, will unite." If we cut a frog across, we may make the legs move for hours, by applying the zinc and silver; or, if we suspend the lower half, by a wire, from the conductor of an electrical machine, we shall, by taking sparks from the legs, exhibit a very grotesque dance.

THE tortoise will live, after decapitation, for many days; and, if we may credit naturalists, has been known to survive the extraction of the brain for half-a-year. The bodies of some serpents will move about, when irritated, even after being deprived of the head, skin, and heart. Kaau tells us of a cock, who run thirty feet after decapitation; and many

other instances, of a similar nature, might, if necessary, be added.

From all these facts, it appears, that the nervous system is one great whole, having its energy universally diffused over it, and inherent in every part.

A DOCTRINE similar to this has occurred to many, and, among the rest, to the ingenious Dr. Whyte; but he ascribes to the soul what is here attributed to the nervous energy; and, by this theory, is obliged to involve himself in metaphysical reasonings, concerning the extensibility of the soul, as taught by Gassendi, and others. According to him, when a muscle is removed from the body, and placed at ten yards distance from the body, the soul extends to it over all that part of space, and enables it to contract. When this muscle dies, then we must either

suppose that part of the soul is lost, or that it retracts itself again within the body; which being less than formerly, must have a greater proportion of soul; both of which suppositions would be ridiculous*.

Of the Nervous Energy

MANY have undertaken to ascertain the precise nature of the nervous energy; and the manner in which it is produced; but I apprehend, that no argument will be necessary to prove the vanity and absurdity of the attempt: It eludes all our researches; it does not come under the cognifance of our senses; and we might just as reasonably attempt to describe and

* Vide Whyte's Works, p. 302. "Of the Vital and other Involuntary Motions."

comprehend a new sense, or detail the intimate nature of an unknown substance.

THE ancients believed this energy to be of a gaseous nature, and maintained, that it was formed in the ventricles of the brain, from the air which we inspired *. This air, according to some, operated in part indirectly, through the medium of the lungs; but it was allowed by all, to act chiefly, by a direct ascent to the brain, through the cribriform lamella of the ethmoid bone. Those who were resolved to adopt implicitly whatever the ancients desired them to believe, were glad to forget the olfactory nerve, which filled these holes up completely, and chose rather to remember the pretended experiment, in which tobacco was found to tinge the brain, by being snuff-

* Galen de Util. Respir. cap. 5.

ed up the nose *. This supposition being, as they thought, proved, physiologists began to push the doctrines of the ancients still farther: They took up the conjecture where they ended, and attempted to explain the particular nature of the aëri-form principle. Some called it a very thin air, impregnated with nitre; others, a mixture of air, sulphur, and saline matter: And, as every one is fond of making his own discoveries as important as possible, we find Mayow attributing this property to his, nitro-aërial or oxygenous principle. This supposition was, in a manner, repeated by Barbieri, and has, of late, been revived by Dr. Girtanner, who can fill bottles, as well as nerves, with this principle of life and irritability.

NOT less ridiculous than these conjec-

* Fracassatus de Cerebro, p. 328.

tures, was that of Mistichelli, who imagined, that the nervous energy was produced by a kind of fermentation taking place, between what he called the sulphur of the blood, and a particular kind of air; or the conjecture of those who believed, that hartshorn was the true nervous spirit*.

THOSE who attended less to chemistry, and more to anatomy, disbelieved these notions, and taught their own disciples, that the nervous spirit was not so very volatile; that it bore a more near resemblance to the other fluids of the human body, and consisted entirely of a finer portion of the lymph†.

THE Cartesians, who loved wonders,

* Cheyne in the Phil. Princip. of Religion.

† Berger, p. 269.

called it pure flame, or a kind of neutral substance between flame and air^{*}; whilst the Newtonians, forgetting the accuracy which mathematics might have taught them, imagined their æther to be the principle of life. The supposition which Sir Isaac Newton threw out, in the form of a query, was adopted by many, and, amongst others, by Dr. Mead, who observes, that “this fluid, (the nervous energy,) so far as we can discover by its effects, is a thin volatile liquor, of great force and elasticity, being indeed most probably a quantity of the universal elastic matter (æther), incorporated with fine parts of the blood, separated in the brain, and lodged in the

* Although they believed this, yet they were foolish enough to talk of valves in the nerves, as if this matter could be obstructed or regulated by valvular folds. Vide Descartes de Homine.

* fibres of the nerves. This is the instrument of muscular motion and sensation, a great agent in secretions, and indeed in the whole business of the animal economy*." *Brain to itself and to the organs of its domain.*

OTHER physiologists rejected this conjecture, concerning the action of a supposititious principle, and referred life to the operation of causes with which they were better acquainted. Magnetism and electricity were too wonderful agents to be overlooked: The last was by many supposed to constitute the nervous energy, and even of late we find some supporting a similar doctrine †.

* * Mead's Works, 8vo, p. 14.

† See the experiments of Valli, Galvani, and others, on this subject. "The similarity of the texture of the brain to that of the pancreas, and some other glands of the body, has induced the inquirers into this subject to be-

PARTLY, perhaps, from the absurdity of these notions, and partly from chimerical principles, the very existence of a nervous fluid was denied, and the agency of the soul or mind became more attended to. That the phenomena of life depended upon the rational soul, without the assistance of any other energy, was the opinion of some; whilst others allowed the existence of a peculiar power in the nerves, but maintained, that this was, to

“ lieve, that a fluid, perhaps much more subtle than the
 “ electric aura, is separated from the blood by that organ,
 “ for the purposes of motion and sensation. When we re-
 “ collect that the electric fluid itself is actually accumulat-
 “ ed and given out voluntarily by the torpedo and gymno-
 “ tus electricus; that an electric shock will frequently sti-
 “ mulate into motion a paralytic limb; and, lastly, that it
 “ needs no perceptible tubes to convey it, this opinion
 “ seems not without probability; and the singular figure of
 “ the brain and nervous system seems well adapted to dis-
 “ tribute it over every part of the body.”

Darwin's Zoonomia, Vol. I, p. 10.

the utmost extent, under the controul of the soul, which presided, as an autocrator, with wisdom, over all the operations of the living body.

HAVING given up the doctrine of a nervous fluid, it became necessary to explain how the nerves performed their various offices, particularly those of motion and sensation, and how external stimuli acted on them. This they endeavoured to do, upon the mechanical supposition of tremors and oscillations, which were excited by the impressing cause, and propagated along the whole course of the nerve. Much time was spent in examining the fibres of the nerves, and their direction; nor is there almost any course or direction which was not attributed to them*.

* Some supposed that the nerve consisted of spiral fibres, which could shorten and elongate; others, that it had ru-

ANOTHER set of physiologists united the two theories, and admitted both the existence of a nervous fluid, and the action of tremors*.

CONCERNING the absurdity of all these opinions, I think it unnecessary to make any observation. The doctrines survived, for only a very little time, their inventors; and the more intelligent part of investigators soon came to confess their ignorance of the nature of this principle,

If the notions which the older physi-

gists, which might be made greater or smaller; and that on this depended the action of the nerves. Whenever the nerve was tight, then the sensation was acute; and vice versa.

* This opinion has been in part revived by Dr. Darwin, who supposes that the vital spirit produces motions or contractions; and builds his theory on the different kinds of motion.

tians entertained concerning the nature of the nervous energy were erroneous, we are not to expect that their explanation of its operation, or their application of their knowledge to the cure of diseases, should be more perfect. Their systems were full of quick motions and * slow motions of the nervous spirit, and tensions, and contractions, and relaxations of the nerves themselves, and fermentations, explosions, impulses, and pre-established harmonies. We may wonder how this could be suffered by men of sense, or how they could possibly explain

* Part of the nervous spirit was, in their opinion, exhaled into the cavities of the body, or, by insensible transpiration, from the body; the rest was returned from the nerves, by the veins, to the heart, and sent from thence to the brain. Others supposed, that it passed into glands, or was condensed into lymph, and thus returned to the head through the medium of the heart. See the Works of Regius, Segerus, Oavet, Lancisi, Targirus, &c.

diseases on these principles; but the wonder ceases, when we know that they founded their system of pathology more on the blood and imaginary humours, than on the nerves: Their doctrines were either chemical or mechanical, and they knew nothing of the peculiar and varied action of the nervous system.

CONCERNING the true and precise nature of the nervous energy, nothing ever can be said; because it never can come under the cognisance of our senses; and even concerning its production and operations a very great deal is conjectural. We know, however, that there is such a principle, and that this principle, by the application of certain stimuli, exhibits certain actions or operations which are essential to life, and in which it consists. These actions, in the aggregate, may be

called the natural and healthy action * of the system ; and the presence of this action is absolutely requisite for the continuance and support of the energy † ; for,

* It is not easy to give such a definition of the *natural action* as shall not be liable to be misunderstood. It does not consist of digestion, secretion, &c. considered as a group of separate and distinct functions, but in a peculiar indescribable condition, which exists in health, and of which these operations are effects, rather than parts : Still, as the right performance of all these functions depends upon the natural and healthy action of the system, these, taken collectively, may give some idea of this action. Part of the natural action consists in the renewing or producing of the nervous energy, which is to be considered as a species of secretion.

† It may be said, in objection to the supposition that the renewal of the energy is an immediate and direct effect of the natural action, and flows necessarily from it, that, were this the case, an increase of the natural action should not produce weakness in the end. But this idea proceeds from not rightly understanding the natural action, which is not a distinct assemblage of functions, but a general and peculiar condition, of which these functions make a part ;

whenever the action becomes changed, either in degree or nature, weakness is the consequence; and this weakness is proportioned to the difference betwixt the diseased and natural action of the system.

THE brain has, by almost every physiologist, been considered as the preparer and source of this energy; and, even in the present day, is ranked amongst the secreting glands. That this energy exists in the brain and nerves, and that it exists in greater and less quantity, at different times, is undoubted. The

and, therefore, although an increase of a particular function, such as muscular motion, does expend more energy than is produced, and consequently weakens, yet a general increase of natural action, if it be not to such a degree as to change its nature, and thus impair it, does augment the quantity of energy, and produces strength; if it be changed, then it weakens.

embryo contains less energy than the child, and the child much less than the adult. He who is reduced, by abstinence and long sickness, has much less energy than the healthy and robust man. These facts require no proof; for the imbecillity of the natural action of those people, and their inability to support disease, proves it beyond doubt *. It is necessary, however, here to remark, what

* It is likewise certain, that particular parts of the body have less energy than others, and, consequently, less action. A part is only capable of acting by means of its energy; and the degree of the one must always correspond to that of the other. The capability of supporting disease is proportionate to the strength or degree of natural action: Hence children bear disease worse than adults, and weakened parts worse than those which are strong: At the same time, we cannot expect to see the diseased action so great in them as in the strong, although it is such as to destroy them; because the energy which is to support it is less. Still, although it be not considered as absolutely as strong or great, yet, relatively considered with regard to the power, it is greater.

will be afterwards more fully explained, that we are not to confound an appearance or feeling of weakness with real and absolute diminution of energy*; because certain temporary morbid actions may take place, which, by their diminution of the natural action, for a time, give the appearance of weakness. This proceeds sometimes from a simple diminution or suspension of natural action; at other times, from the energy being employed in an action dissimilar to the healthy one. At the same time, if this

* Whenever the natural action is lessened, weakness is felt; and this is more observable, in proportion as the diminution is sudden. Emotions of the mind, and many other causes, by lessening suddenly the natural action of the system, produce syncope; but, in a few minutes, the person is often as strong as ever. Here we cannot suppose a sudden loss and restoration of energy; it was only the action which was affected; but, had this action continued for any considerable time, then real loss of energy would have followed, upon the principles already laid down.

action does continue for any considerable time, real diminution of energy will take place; because a certain action is necessary for the support of the energy; and, in health, this action always bears an exact proportion to the degree of energy. The action of the energy is often very suddenly lessened, in which case, weakness or syncope is the consequence; and often it is as suddenly restored, in which case our strength returns. Energy may be suddenly lessened, but it never can be suddenly restored.

This energy is not produced in consequence of the structure of the nerve, or by any power proper to the nerve, and necessarily connected with a medullary texture. If it depended on structure alone, man should live as long as his fabric remained unimpaired; and if it depended on any peculiar power of the

nerves, distinct from the action of the energy itself, we must acknowledge a new principle; we must observe its operations, and ascertain what causes influence it, which will only multiply difficulties.

It may perhaps be supposed, that the energy remains almost always the same, and that its action or operation only changes; but, in this case, whenever any action ceased or decreased, the quantity of energy should accumulate, which is an absurd idea. Some suppose an accumulation of the living principle; but the idea is ridiculous; for energy can never exist without action. Action requires energy; it consumes the energy, which must be replaced. If this were not the case, we need only excite the action by stimuli, and life, should go on. As long as the blood circulated, action and life

should be kept up, even without food. Death indeed would at last take place, from want of materials to supply the body, considered mechanically; but still the man should live for a long time, and until he consisted of little else than bones, nerves, and vessels. Man might, upon this supposition, be rendered immortal.

Of the Blood.

For the support and production of the nervous energy, a certain substance, namely, arterial blood, is requisite. This fluid, by its circulation, not only acts as a natural stimulus to the nerve, exciting and supporting its action, and thus enabling the energy to subsist, but it also affords the materials from which the energy is drawn. It was formerly mentioned, that there is nothing which

can be called truly dead; that a vital principle pervades every substance, and extends its influence over the whole universe. This principle, it was mentioned, exists, in different degrees of delicacy, in the different classes of nature, and exhibits a regular gradation of perfection, in the different individuals. Common matter possesses a peculiar kind of life: When this matter is taken into the vegetable, not only its organisation, but also its life, is changed, and we observe a very different appearance, both in the mechanical and vital system; but, when the vegetable is destroyed, then it becomes again, both in its substance and life, the same with common matter. When the vegetable is taken into the animal system, we likewise find a change, both in life and texture. We have then a certain gradation, which remains uniform; the material part of the one class forms the material

part of the other, and the vital principle of the one forms the vital influence of the other*. This change uniformly begins in the fluids. In the vegetables, the sap, and in animals, the chyle, which forms the blood, is the first step towards the change of life. These substances consist of matter, having a life proper to itself, differing as much from the active principle of common matter, as it does from the peculiar life of the individual, considered as an organised body, and a whole.

FROM the blood is formed the material part of the animal, and likewise its life, or nervous energy. Neither the material part of vegetables can be convert-

* It must here be observed, that there is a material distinction betwixt life and soul, or mind: They differ essentially in their nature and operations.

ed directly into animal substance, nor their vital principle into nervous energy; There must be intermediate steps, and these are the chyle and blood. Vegetables, when alive, differ from animals, in composition, in organisation, and in the qualities of their life. When taken into the stomach, and in a state of digestion, they differ from animal substances, in the same circumstances; but, when the living power of the animal has begun to operate in the formation of chyle, the distinction no longer subsists, at least to the same extent. A new substance is formed, and from this another, which is the blood; and from this an organised substance results, possessed of a more intricate structure, and a higher species of life*.

* Every part of the body dies, and is replaced. If even a small part be removed, it is reproduced, and the

BESIDES this source of the living principle, arising from the conversion of food into blood, and the consequent change of the one kind of life into the other, the blood likewise derives vitality from the air, during respiration. It may be considered as a fact, that whenever matter becomes part of a vegetable or animal, its active principle likewise becomes changed or elevated into the specific life of the individual of which it becomes a part. Now, we know, that, in the course of 24 hours, about 8640 cubic inches of oxygen * are combined with the blood, and

new matter possesses the properties of the old. The nerves themselves, if divided, will unite; and the uniting substance is, to all intents and purposes, nerve. See Dr. Haighton's Paper in the Phil. Transf. on the Reproduction of Nerves.

* It is computed by chemists, that, besides the portion of oxygen, which combines with the carbone and hydrogen, in respiration, 360 cubic inches of that air *disappear* in an hour,

become a constituent part of it, which affords a very abundant supply of vitality. The constant action of the system requires a much more frequent renewal of life, than we can suppose to be yielded by the food, when converted into chyle and blood. We likewise find, that, in many diseases, no food, or almost none, is taken into the stomach, for weeks, although the action of the system be very great*. Respiration is a constant and

This oxygen changes its state in the blood; for I know of no experiment which proves, that it is found in a gaseous state in the blood. This opinion, of respiration being subservient to the production of vitality, is also adopted, in one respect, by Dr. Darwin, who supposes, that an æthereal fluid is yielded by the air to the blood, and secreted from it again by the brain. *Zoonomia*, Vol. I. p. 471.

* The drink used during illness, may reasonably be supposed to assist in the production of vitality; but it cannot of itself yield enough. By being long boiled with a little farinaceous substance, water yields more nourishment, and more life, than either it or the farina would do separately

uniform source, from which the expenditure of energy can be, in some respect, supplied; because the active principle, in oxygen, is thus conveyed to the blood, during its combination with that fluid; but respiration alone, without food, is not adequate to the necessities of man, both because the life thus attained is not equivalent to the demand, and also because the materials of nourishment are withheld. The vitality yielded by the food, is, if I may so speak, more permanent, and is united with the structure of the body, when the deposition of new matter is made by the blood. The vitality furnished by the air seems to be yielded to the nerves, during the course of circulation, for the immediate performance of the actions of the system.

and unboiled; but, in sickness, it is not employed in this form. See Count Rumford's *Essays*.

• As the elevation of life, or the conversion of the lower into the higher, begins in a fluid state, so also does its descent. The solid parts of animals are continually changing into a fluid or lymph, which is thrown out of the body*, as unfit again to become organised animal substance, until it has undergone new changes, and been converted either into vegetable matter, or animal substance of a lower degree. Even the nerves themselves terminate directly in a soft and fluid matter; and perhaps it is only when the nervous energy is leaving the body, that it is

* This lymph is, along with the chyle, poured, by a common trunk, into the subclavian vein. It is then, after passing through the lungs, circulated along the body, and is, most probably, the substance from which the different excretions are formed; It is thus thrown out of the body, and begins to assume new states and conditions, and to answer other purposes, in the general and extensive operations of nature.

capable of action; at least, we find, that action is uniformly attended with an expenditure of energy; and the greater the action, the more speedy is the loss of energy: We likewise know, that it is only the extremities of nerves which act.

I HAVE said, that for the production of this energy, and the support of its action, the presence of arterial blood is necessary. This is one of the natural stimuli to the system, and excites those operations of the nervous energy which are necessary for life, and which, in the aggregate, are called the natural action. This action is, in common language, called life*, whilst the energy which

* This expression came to be used, from observing, that whenever this action ceased, the body was dead. In the same way, we apply the word heat to the sensation or action which it produces oftener than to the principle which causes it, which of itself is not hot.

produces it, being unseen, is overlooked. The continuance and presence of this action, is necessary for the preservation of the energy in the body, and for its production. Arterial blood, then, is of the utmost importance, as it not only affords the material from which life is drawn, but also is one great cause or exciter of that series of operations, which are necessary for the renewal of the energy, and its preservation in the system.

This fluid has, at all times, received particular attention from physicians, and its composition has been examined with more accuracy than perhaps was necessary for the practice of physic. But, as formerly the systems of pathology were founded almost entirely on the different states, real or supposed, of the blood, we cannot wonder at the attention which was paid to it. Notwithstanding the

many observations which were made upon this fluid, and the various opinions which have prevailed concerning it, it is only of late that it has been supposed to differ from common matter, or to possess any living principle.

MR. HUNTER, who was the first who taught that the blood was alive, founded his opinion, not upon general reasonings on the nature and extensive operations of a living principle, or upon the necessity of the thing, but upon the observation of certain particular phenomena, and especially on the coagulation of the blood. This living principle he supposes to be the same with that of the rest of the body, and that something similar to the brain is distributed through the blood*, which

* "I would consider, that something similar to the substance of the brain is diffused through the body, and

he calls the diffused matter of life. This conjecture cannot be admitted; because, in the first place, it supposes, that life depends upon a particular substance or species of matter; and, in the second, we cannot see how, or by what power, this

“ even contained in the blood, and between this and the
 “ brain the communication is kept up by nerves.” Hunter
 on the Blood and Inflammation, p. 89.—Are we then to
 consider that the brain is a mass of life, and that a similar
 matter is diffused over every part of the body, and floats in
 the blood; that the nerves are quite different in their na-
 ture from the brain, and consist of different materials, and
 are endowed with a different and distinct power or prin-
 ciple, acting merely as connecting lines betwixt the life of
 the brain and the life of the body, or literally as chords
 internuntiate? Does life indispensibly require, for its pre-
 sence and existence, something similar to the substance of
 the brain? and does it exist wherever this medulla is to be
 found? Do we observe any thing like this in plants? Do
 we see it in muscles, in ligaments, in bones? or has it ever
 been detected in the blood? Vitality may exist in sub-
 stances, with very different structures and organisation; and
 I have already mentioned, that the living principle itself va-
 ries very much in different individuals and classes.

substance is to be formed in the blood, I have already mentioned my idea of life, and its gradation; and also, that the blood seems, in a perfect animal, to be the first step toward the conversion of common and vegetable matter into a substance possessed of animal life; but that this life differs as much from the peculiar life of the animal, as it does from that of the matter from which it is formed. Blood is to be considered, in one respect, as extraneous to the body, operating and exciting to action as an extraneous body, and yet possessed of powers, which show it to be endowed with a peculiar life. We are to consider it in two views; first, absolutely, as a living animal substance, having peculiar properties, and consisting of different parts, kept together by life, and separating, when dead or dying; Second, relatively, as the source of increase and nutrition,

and as making a part of the animal body, acting upon it as a stimulus, and being itself acted upon by the vessels which contain it. This reciprocal action and reaction is absolutely necessary for the preservation of each; for, if either fail, both die. As long as the blood is alive and perfect, it produces the life of the animal, and supports its action; and, as long as the animal and its vessels are living and healthy, the blood is kept perfect and alive. When the animal becomes diseased, the life of the blood becomes also affected, and its peculiar quality is injured. The proper characteristic of blood, considered absolutely as a living substance, is its tendency to become solid, or coagulate. If its vitality be not previously injured, it uniformly becomes firm, and its parts separate, as soon as it is removed from the action of the vessels; and, whenever this coagulation takes

place, it ceases to be blood; it dies. Mr. Hunter supposes, that this coagulation is to serve a useful purpose with regard to the body, and particularly, that it becomes the means of nourishment: But nourishment and increase depend upon a much nicer process; and coagulation never can, and never does, serve any useful purpose, otherwise than mechanically stopping a hemorrhage; in which case, it is precisely similar to any other dead body; and, whenever coagulation does take place, it becomes absolutely useless to the animal, in any other point of view, and can no more serve the purposes of blood, than the curd of milk can. Mr. Hunter, however, is of a very different opinion; for he believes, that the coagulum is still, alive, and possessed of the power of action within itself; that it can form vessels, unite itself to the surrounding parts, and assume actions and appearances ac-

cording to the nature of the surrounding
 parts. " The moment it is at rest, (says
 " he,) it begins to form itself into a fo-
 " lid, and changes into this or that par-
 " ticular kind of substance, according to
 " the stimulus of the surrounding parts,
 " which excite this coagulum into ac-
 " tion, and make it form within itself
 " blood-vessels, nerves *," &c. If this
 were the case, an aneurism ought never
 to burst; because, when the blood coa-
 gulates, the old coat of the vessels ought
 to assimilate it into a new one. Every
 observation confirms the opinion, that,
 when the blood coagulates, it dies; but
 how or why it does coagulate, never can
 be ascertained, more than how or why
 other actions are performed, the utility of
 which we do not clearly discern. Arterial
 blood coagulates rapidly, and into a mass:

* Hunter on the Blood, &c. p. 86.

Veinous blood coagulates slower; the serum separates freely, but the red globules are mixed with the lymph. In some diseases, it is still slower, and a buffy crust is formed from the separation of the globules. In others, it never takes place; the blood, from the action of the body, being almost deprived of its vitality, before it can come into a state of rest. This we see in the effects of great fatigue, lightning, poisons, bad fevers, &c.

THE complexity of the vascular system appears, in every animal, to be proportioned to the perfection of the nervous system; and the purity of the blood uniformly corresponds to the delicacy of the living principle. It would be useless here to mention all the mechanical variations which take place in the heart and vessels of different animals: It will be sufficient

to observe the particular conformation which affects the purity of the blood. In every animal, where the living principle is naturally of a low degree, (by which I mean, of a kind incapable of exhibiting the actions of an animal, in the perfect manner in which they are performed in man,) the blood is impure.

IN the frog, we find a heart, consisting of one auricle and one ventricle: The blood, being returned from the body by the veins, goes into the auricle, and from thence into the ventricle: This sends out a large trunk, which soon divides into two: These again, shortly after the first division, subdivide into other two branches: One of these branches, on each side, goes to the lungs, and the other turns down, to join with the one arising from the other side: These last uniting, form a large aorta: The branch-

es, which are distributed on the lungs, or bladders of air, carry their blood thither, from which it is returned into the auricle. But I have already said, that all the veinous blood from the body was also returned to the auricle: There must, therefore, be in the heart a mixture of arterial blood from the lungs, and veinous blood from the body; and it is this impure blood which circulates in the arteries, and supplies the body.

IN the turtle, we have distinctly two auricles and two ventricles, forming a double heart, similar, in this respect, to the heart of man; but, as these two ventricles communicate by a hole in their septum, they are to be, in reality, considered only as one cavity. From the right ventricle, or, more properly speaking, the right side of the joined ventricles, arise the aorta and pulmonary ar-

tery; the one supplying the body, the other running directly to the lungs, from which the blood is returned, by the pulmonary vein, into the left auricle; from this it is sent into the left ventricle, and thence, through the hole in its septum, into the right ventricle; so that, setting aside all this round-about course, we may say, that the blood is returned from the lungs into the right ventricle. The blood, again, which is sent out by the aorta, is returned, by the vena cava, into the right auricle, and from this into the right ventricle, where it meets with the blood from the lungs. There is, then, a mixture of veinous and arterial blood in the turtle, just as in the frog; and this mixture is sent again, in part, through the lungs, and the rest through the body.

IN the crocodile, the same happens;

only, the two ventricles have no septum, but form one bag, without any division.

The consequence of this construction, in these animals, is, that the blood, which is sent to the lungs, is never entirely venous, but partly venous and partly arterial, by which the supply of air will last longer, and the animal require to breathe less frequently. But, secondly, the effect of this construction, and the consequent impurity of the blood upon the system, is, that the life of the animal is of a less delicate nature, than that of those animals, where the blood is pure: Their action is not raised to such a degree, as in the higher classes; and all the operations of their system are of a lower nature. This, which is an imperfection in one sense, is, however, a degree of perfection, greater than we find in man, if we view life only with regard

to its preservative powers; for those animals, whose life is of so low a kind, that it is not susceptible of quick actions, are a long time of being destroyed, by such causes as would instantaneously kill any of the higher classes: We may remove their brain, and thus materially injure that system, in which the specific life is resident; we may cut out the heart, and thus destroy the circulation; or, we may prevent the purification of the blood, by removing or cutting up the lungs; and yet the animal, under any or all of these causes, will continue to live for many hours, sometimes for months.

WHERE the life is of the highest kind, but its quantity naturally small, and the action required, at a particular time, is very little, we likewise find the blood impure. This we see to be the case in

the foetus in utero, where the action required is very trifling, and where the heat produced* (which generally bears a proportion to the natural purity of the blood) is little.

IN the child in utero, “† the blood
“ is received pure from the placenta by
“ the umbilical vein, and is conveyed
“ by it to the navel of the child. Here
“ the vein enters, and passes into the li-
“ ver, dividing in it into many branches,
“ which ramify through the substance of
“ that gland, whilst the continuation of
“ the trunk runs forward, and termi-
“ nates in one of the branches of the ve-
“ na portæ. Thus, we find, that one

* As the foetus is placed in a medium as warm as itself, very little heat is necessary to be produced, in order to keep it at its proper standard.

† Anatomy of the Gravid Uterus, p. 135. et seq.

" portion of the pure blood of the um-
 " bilical vein is distributed to the liver,
 " whilst the rest is sent directly to the
 " right auricle of the heart ; but, previ-
 " ously, it is mixed in its passage with
 " the impure blood in the vena portæ
 " and vena cava.

" THERE is, then, by this contrivance,
 " a mixed blood in the right side of the
 " heart, which is purer than the venous
 " blood of the foetus, but much less arte-
 " rial than the blood of the arteries after
 " birth ; from which we may infer, that
 " a very great change takes place in the
 " system and constitution of the child
 " after delivery. When the right ven-
 " tricle contracts, the blood is not sent
 " through the lungs, as it is after birth,
 " but directly into the aorta, at its cur-
 " vature, by a vessel running from the

" pulmonary artery into the aorta. By
 " this construction, we see that very
 " little blood should enter the left auri-
 " cle; and, consequently, that the whole
 " left side of the heart should be al-
 " most empty. But, to prevent this cir-
 " cumstance from happening, we find
 " an opening or valve in the septum, be-
 " twixt the auricles of the heart, which
 " permits the blood to flow from the
 " right to the left side directly, and then
 " the whole heart is equally filled. It
 " is for preserving the heart in a state
 " fit for acting after birth, that we
 " have both a foramen ovale, and a
 " ductus arteriosus. Either of these,
 " individually, would have served the
 " immediate purposes of the foetal cir-
 " culation: But, by thus dividing the
 " blood, both the pulmonary artery and
 " the left side of the heart are kept

“ of a proper size, and in a due state of
 “ action*.

“ By the aorta, this semi-arterialized

* “ The use of the sides of the heart is, in one respect,
 “ the reverse in the fœtus of what it is after birth. In the
 “ fœtus, the right side receives the purest blood, whilst the
 “ left receives it after birth. In the adult, the blood which
 “ is in a state fit for circulation, is collected in the left side;
 “ and, therefore, the great artery of the body arises from
 “ that side. On this account, there must of necessity be a
 “ communication betwixt the aorta and the right side of the
 “ fœtus, which performs the functions of the left side of the
 “ adult heart. If this communication does not close up
 “ after birth, then the contents of the right side continue
 “ still to be sent into the aorta. But as the quality of the
 “ blood of the right side is now materially different, very
 “ different consequences take place from those which re-
 “ sulted from the same mechanism before birth. The
 “ whole blood of the body is now rendered impure, the
 “ purposes of circulation are only half performed, and the
 “ unfortunate individual drags on a most miserable exist-
 “ ence, until he sinks prematurely into the grave. One
 “ man, from whom I procured a preparation of this kind
 “ of heart, lived this unhappy life for forty years.”

" blood is distributed to the body ; but,
 " instead of the whole blood in the de-
 " scending aorta being conveyed to the
 " viscera and inferior extremities, one-
 " half of it is sent directly to the pla-
 " centa ; for the internal iliac arteries
 " turn upward to the navel, through
 " which they pass, and form the two
 " umbilical arteries. The blood, there-
 " fore, which is returned to the placenta,
 " is as pure as that which circulates in
 " the arteries of the child, and, therefore,
 " requires a less change to convert it in-
 " to the state in which we find it in the
 " umbilical vein."

If, by any means, the blood be not
 sufficiently purified, or, in other words,
 if it do not possess, to a sufficient degree,
 the properties of blood, we find, that the
 powers of life are small, the actions of
 the whole system are imperfectly carried

on, and the individual sinks prematurely into the grave. When, as has been already mentioned, the adult heart remains in the same state with that of the fœtus; when the pulmonary artery is deficient; when the two ventricles communicate, and the aorta arises from each; or, when the lungs themselves are injured, or ill-formed, then the most distressing symptoms take place; distressing, on account of the general condition of the system, but still more painful, from the local affection produced in the chest. The effect, however, of the want of arterial blood, is more immediately seen in cases of suspended respiration. In hanging or drowning, death is produced by the want of arterial blood; and the universal method of cure has been, to attempt the restoration of respiration, although this has not always been done upon the true principle. By inflating the lungs, respi-

ration is often restored, but it also very frequently fails; because the mere blowing in of air neither infallibly excites the action of the lungs, nor does it, as some suppose, change the blood; for this change is an action dependent on life, and cannot be imitated by the chemist more than digestion. The alteration of the blood does not depend, as many imagine, merely on the presence of air; a peculiar action of the lungs, or their vessels, also is necessary. Food and air are to be considered in the same light, both only supplying materials for the system to act on, and not themselves acting independently of the animal. When inflating the lungs does not very speedily restore their action, and consequently the change of the blood, we ought to transfuse arterial blood from another animal, and thus reduce the person to the state of the foetus, whose blood is purified by lungs out of the body.

Of the Pulse.

I HAVE said, that it is the pure or arterial blood alone, which is valuable to the system, considered as a whole, and which preserves the life, and yields the nourishment of the body. This is sent out from the heart, as a source to all the different parts of the body, by regular and continued contractions of the heart and arteries; and is returned by the gentler action of the veins. These contractions depend upon the living principle, connected with the muscular coats, and must be influenced, in their frequency and force, by the state or action of the energy of the system in general, with which they sympathise in a very great degree*.

* Many disputes have taken place concerning the action of the heart; some referring it to the influence of the

THE nervous and vascular system mutually react on each other; and, therefore, we find it of use, in disease, to attend to the state of the vessels; because, as the changes induced on them are some of them of a mechanical nature, we can more easily detect them than the nicer alterations in the action of the nervous system, were we to confine our attention to that system alone. The state of the pulse, then, is of importance to be attended to,

nerves, and others of a *vis insita*. If I have been right in my position, that the energy is universally diffused and inherent in every part of the nervous system, I apprehend that the arguments in support of the existence of a *vis insita* will not have much weight. This controversy is to be found stated in Haller's *Elementa Physiologiae*, tome I.

Praxagorus referred it to a *vis pulsifica*, or peculiar pulsatory power; others to an innate heat, which rarified the blood, whilst the air cooled it, and that this alternate operation produced pulsation; others ascribed it to fermentation.

and will lead us to ascertain the presence, and sometimes the nature, of many morbid actions and deviations.

THERE are several parts of the vascular system, by the action of which, individually, the pulse may be affected. The heart, and great artery, the smaller arteries, and the veins, all influence the pulse; and it is easy to ascertain to what degree any of these parts operate.

THE heart is the origin of motion, and gives to the pulse its particular feeling, with respect to motion, such as regularity, frequency, slowness, intermission, fluttering, &c. *

* These particular states of the pulse always depend upon the heart. In all increased actions of the living principle, the heart is affected, and contracts oftener. In all instances where the heart is affected locally, we have irregular contractions or intermissions, as we find to be the case in spas-

THE arteries act partly by their elasticity, and partly by their muscular power: The muscular power is greatest in the smaller arteries, and the elasticity in the larger; the one diminishing as the other increases: The aorta is the most elastic, and the least muscular; and, therefore, its action depends chiefly upon that of the heart, to which it is to be considered as an appendage: The action of the smaller arteries, again, depends much upon their own contracting power; but not entirely on this; for the elasticity of their coats likewise operates, unless the artery be very small, in which case it has no elasticity.

THERE are, then, in the arteries of the
modic affections of the heart, or its great vessels, malformation of the heart, diseases of the aorta, or pulmonary system, &c.

arm, for instance, two causes, operating in producing and influencing the pulse: First, the elasticity of the artery; and this cause is affected by the heart: Second, the muscular contraction of their coats; and this is affected only by their own condition, independently of the force of the heart. As the heart, then, gives to the pulse its particular feeling, with respect to motion, so does the contraction of the artery give to it the particular feeling, with regard to size and quickness of contraction, producing the conditions of fulness, smallness, hardness, softness, &c.

THE veins, like the arteries, act partly by elasticity, and partly by muscular contraction; but the order is reversed in them; for the greatest veins seem to have most muscular action, whilst the small ones have none, or almost none.

The auricles of the heart belong to the venous system, and the ventricles to the arterial. The action of these two parts of the heart is alternate; and, therefore, the action of the arteries and the veins is likewise alternate, the one dilating, whilst the other contracts. In health, the action of the veins and arteries correspond exactly, and a regular and equable circulation of the blood is kept up; but, in disease, they often disagree, at least in the commencement of the diseased action; for the veins are less irritable than the arteries, and are longer of being affected*.

* External heat, and many other agents, induce a fulness of the veins for a time, until the equilibrium be restored; and, in many instances, we feel the accumulation of blood in the larger and internal veins. This state is often attended with a small quick pulse, marking a contracted state of the arterial system. The skin is pale, and the body often appears to be shrunk, as we see in the commencement of febrile diseases.

THERE are, then, three causes which affect the pulse; and, by attending to the state of the vascular system, we may ascertain the proportion in which these operate, in any particular case: First, the heart and aorta; second, the branches of the aorta, or arteries of the body; third, the venous system.

A HEALTHY pulse contracts slowly and regularly, and the pulsations do not exceed about seventy in the minute: We feel the artery rising softly against the finger, with a moderate degree of fullness. In disease, the pulse becomes either slower, or more frequent, full, small, hard, weak, or strong*. These condi-

* Practical writers have admitted of an almost infinite variety of pulses, which are now believed to be, in a great degree, imaginary, and therefore are overlooked. As a specimen of this, I shall only subjoin an extract from the

tions it is impossible here fully to describe. I shall, however, keeping the general observations already made in remembrance, make one or two remarks upon some particular states of the pulse.

Compend. Med. of De Gorter, who, although he enumerates many distinctions, which we now set aside, yet has not given the third part of what many others mention.

“ Si cor singulis ictibus majori vi contrahitur, sanguis celeriori impetu in latera arteriarum ruens eas dilatat solito magis, quæ dilatatio digitis percepta, si non multo major solito, *robustus fortisque pulsus* dicitur et *validus*; notans cordis vigorem, et copiam sanguinis singulis ictibus ejecti: in morbis bonum præsagium, nisi ob cerebrum compressum ut in apoplecticis, et contusione cranii, animi deliquio scorbuticorum, aut ob compressionem notabilem rami arteriosi hujusmodi fiat pulsus.

“ *Vebemens* autem pulsus, digitos veluti removens ab arteria, nec quiescens fortiori digitorum compressione, ut in sanis fieri solet, fortissimam cordis contractionem, quæ spiritus consumuntur, et motum humorum velocissimum sanâ destruentem indicat. Omnia ergo mala, quæ ex his fieri solent, præfigit, et videri possunt in aucta circu-

IN all cases where the pulse becomes suddenly small, we may infer, that the

latione. In morbis acutis inflammatoriis et erysipelatosi observatur.

Quando arteria instar chordæ tensæ dura, contra digitos attollitur, *Durus* dicitur pulsus, fortem indicat arteriæ impletionem, cum impedito transitu sanguinis per arteriæ extrema, membranarum internarum, ut pleuræ, et meningum, inflammationi comes. Si arteriæ simul constringuntur magis, est durus et parvus: alias durus et magnus, qui melior; præfagia ex inflammatione, febreque acuta ardente petenda.

Si, *imo*, cordis contractio imbecillis sit. Ut in cerebri compressione phreniticorum, lethargicorum, delirantium, tetanicorum, soporosorum, vel ex defectu spirituum in perispermis, morbis vehementissimis vires corporis superantibus. *2do*, Si intercipiatur fluxus sanguinis ad cor, ut in peripneumonia, tuberculo pulmonum, pleuritide validissima, sufficientem pulmonis explicatione inhibente; vel per hepar eo sc. obstructo, aut inflammato, vel nimia quantitate sanguinis evacuata extra corpus, vel collecta in cavis, aut vasis dilatatis, ut in hydropicis, empyricis: humoris nimia evacuatione, a partu, ruptioneque vasorum interna. *3tio*, Laxatus tonus solidorum in scorbuticis, hysteriis, stomachi debilitate laborantibus, rachitide, in parte paralytica, leucophlegmaticis, doloribus flatulentis, *4to*, in-

proper balance no longer exists betwixt the venous and arterial system, but that

“ *flammatio et febris ardens, in gangrenam vel sphacelum*
 “ *abiecit. Ita.* In principio invasionis febrilis, pulsus mi-
 “ *nori vi digitos applicatos percussit et attollit, et a com-*
 “ *pressione eorum paulo majori crumino suffocari potest;*
 “ *pulsus hic debilis dicitur a Medicis. Quandoque talis*
 “ *videtur fieri, si multa pinguedine vel tumore aquoso arte-*
 “ *ria tecta sit. Talis pulsus, quia arteria minus attollitur,*
 “ *humilis; minus percipi potest, obscurus; arteriam minus*
 “ *dilatatur, enisus, gracilis, eniguus, parvus; minus implet, va-*
 “ *cuus; tandem in summo gradu deficiens et deletus dicitur,*
 “ *quorum omnium cognitio et predictio ex his clara.*

“ Alterum quod in singulis pulsibus animadvertitur, est
 “ *celeritas et tarditas. Celeritas pulsuum, quamvis a mul-*
 “ *tis Celeritas cum frequentia confundatur, omnino distin-*
 “ *guenda videtur, intelligimus enim per celeritatem, si ab*
 “ *initio dilatationis usque ad integram, et ab ea iterum ad*
 “ *quietem, minori temporis spatio peragitur, quam in sanis*
 “ *pulsibus fieri debet; quod exploratione digitorum facile*
 “ *percipiendum. Si vires deficiant cum humorum defectu,*
 “ *atque quodam stimulo irritante, cor minime momento,*
 “ *veluti ictitans, se contrahens, citissime dilatat arteriam*
 “ *brevi tempore subsidentem. Ut plurimum in cholera,*
 “ *febre et temperamento bilioso, atque febre erysipelatosa*
 “ *observatur. Dicitur etiam velox et ictitans quandoque.*

the one is acting more than the other.
We are not to infer from this state of the

“ Hinc oppositus est, qui vocatur *tardus* et *lentus*, in vis-
 “ ciditate humorum frequens observatur, ut in cachecticis,
 “ scorbuticis, leucophlegmaticis, quod ob sanguinis lentor-
 “ em longius tempus infumatur, antequam integra arteria
 “ impleri potest, et cor evacuari. *Quid aliud ob id collig-*
 “ Cordis actio in pluribus pulsibus aut frequentius, aut
 “ rarius exercetur. Quae pulsationes inter unumquemque
 “ ictum brevius spatium temporis relinquunt, seu si eodem
 “ temporis spatio saepius pulsant, pulsus dicitur frequens, a
 “ quibusdam celeris et velox dictus, sed perperam, indicat
 “ cordis frequentiore contractionem. Quod fit, *Imo*, ab
 “ irritatione phlogistica, ut in pleuritide, phrenitide, et
 “ membrarum inflammatione, quando et *frequens* et *durus*.
 “ 2do, A materia acri biliosa, ut in febribus biliosis et ery-
 “ sipelatosi et *frequens* et *celer*. 3tio, Defectu virium, ut
 “ in principio invasionis febrilis, et circa statum, quando
 “ pessimus, phthisicis, perisurmis, et similibus et *frequens* et
 “ *debilis*; si vero, 4to, vires adaugeantur, ut ex usu Chaly-
 “ bis in chlorosi, singulis ictibus corde maiorem copiam
 “ sanguinis ejiciente, pulsus fit *frequentior* et *major*.
 “ Hinc contrarius est, qui longiori intervallo vibrat, ra-
 “ rius dictus, a multis etiam lentus et tardus, quamvis talis
 “ ad praecedens genus potius pertineat. Blandum indicat
 “ humorem, hoc si ex humorum optabili indole provenit,

pulse, any thing with regard to the quantity of blood in the system; nor are

"vassisque spertis, magnitudinis compensatur parvitas. Verum si ob visciditatem, cerebrum aut cerebellum obfessum tenentem, ut in pituitosis, leucoplegmaticis, catarrho suffocativo, syncope, et sopore, atque catalepsi laborantibus, fiat, rarus et parvus aut debilis, summum periculum imminet, totum cerebellum obstructum iri.

"Præter cuncta hæc pulsuum genera, qui æquales dicuntur, aliud est quod inæquales continet, imò, in unoquoque istui, et 2do, in multis simul. Omnes hi pulsus nunquam quidquam boni indicant, non semper tamen mortis indicium: quibusdam enim satis familiares, in pulmonum morbis et scorbuto frequentes, et in quibus post mortem in corde polypus fuit inventus, aut pericardium cordi adnatum.

"Pulsus singulis istibus inæqualis, tribus ad minimum digitis dignoscendus; et qui cum aliqua dæritie percipitur, *ferretus* a Medicis dicitur. Indicat magnam cordis constrictionem, et inæqualem et variis in partibus arteriæ resistantiam. Idem imò pejora, ut pulsus durus præfagit.

"Si satis magnæ sanguinis quantitas e corde pulsæ arteriam non nimis resistantem unde ad instar succellive extollat, *undeful* vocatur: talis observatur in humorum abundantia, morbisque acutis et inflammatoriis, si crisis per sudorem natura molitur, et quando in suppuratibnem

we to suppose, that the blood necessarily circulates so fast through the lungs, as

- “ abeat ; in morbis autem Chronicis materiam atreubi ha-
 “ rentem in sanguinem receptam esse indicat.
 “ Si cor minori vigore contrahitur, et singulis ictibus in-
 “ aqualiter, minor quantitas e corde in arterias mittitur,
 “ qua arteria successive attollitur, ac si vermis sub digitis
 “ serperet, *vermicularis* pulsus dicitur.
 “ Qui minorem adhuc vim cordis, et quantitatem sangui-
 “ nis indicat, simili modo *formicans* appellatur.
 “ Sed vero qui versus cor magis : et versus extrema mi-
 “ nus dilatatur, quod cor non valeat, vel deficiat tantus li-
 “ quor, ut tota arteria impletur, *missus*, ex similitudine cau-
 “ dae muris a veteribus dicitur. Qui omnes in omnibus
 “ morbis periculosi sunt habendi pulsus.
 “ Qui pulsus plusquam semel videntur attolli, et digitos
 “ ferire, *Dicroti* vocantur si simul debiles ; verum si magis
 “ robustus, *Caprizans* appellatur, raro nisi in periculis ob-
 “ servatur, et agone mortis.
 “ Huic quoque referendus *vacillans* et *tremens*, inaequalem
 “ et inordinatam arteriarum impletionem indicans, ex deno-
 “ minatione facile desumendus ; vires vite fragiles et cadu-
 “ cas indicat.
 “ Inaequalium alterum genus duas continet species, imo,
 “ *Intermittentem*, qui una alterave vice intercalatur seu defi-
 “ cit ; in membranarum inflammatione gangrenam indicat,

we would at first suppose; because, if there be an accumulation in the venous

in acutis pessimus, in pueris vero dormientibus, plethoricis, senibus, præsertim mulierculis familiaris, et quibus cor pericardio accretum est.

2do, *Muscor*, qui singulis ictibus minor sentitur, ut in moribundis, quem iterum ulterius sine necessitate in decurtatos, reciprocos, et recurrentes distinguunt.

Mollis sit pulsus, 1mo, si sufficienter non impleatur, defectu sanguinis, ut in peripneumonia, aliisque pulmonum morbis, atque hepatitide, qui tunc semper malus. 2do, Arteria nimis laxata, ut in scorbuto, leucophlegmatia, quando malus. 3to, Minori influxu spirituum, ut in quiete corporis et somno, bonum indicat; sed in sopore, cerebri oppressionem. 4to, Sedato impetu spirituum in fibras motrices, cum corporis viribus auctis, et pulsus plenitudine, bonus in febribus.

Quantitas humorum in corpore contenta, et singulis ictibus e corde in arteriam ejecta, pulsum *magnum, plenum, altum, latum, manifestum* exhibet, et palpitationem. Qui boni, nisi fiant a nimia copia humorum, vel impedito transfluxu spirituum per cerebrum, ut in apoplexia, lethargo, phrenitide: vel ab obstructione rami notabilia arterie.

Sed singulis cordis ictibus minor quantitas in arterias derivata, pulsum *parvum, vacuum, gracilem, obscurum, debi-*

system, the same quantity will not pass through the lungs, at each contraction of the heart, as passed in health; and, therefore, more will not necessarily pass in a given time.

We are not always, from a small pulse, to infer, that the person is very weak, and requires cordials. On the contrary, whenever this state of the pulse is conjoined with a hardness, we may pursue a contrary plan, and detract blood; because the smallness and hardness of the pulse depends upon the complete contraction of the coats, and marks an action very greatly increased, and which must soon kill, if it be not checked. By opening a vein, we render the

*lem, et etiam deficientem, facit; hoc si fiat defecto virium,
 " ut in sphacelo, catarrho suffocativo, syncope, infirmitate,
 " defectu sanguinis, valde malum: sed in obes, arteria
 " multa pinguedine tecta, nil mali indicat."*

pulse slower, softer, and fuller, as we see in abdominal inflammation. Whenever there is an increased contractile power, producing hardness, we may infer the existence of an action, in some part of the system, of an inflammatory nature, and will often be led to bleed, from this mark alone, when, from other circumstances, we would deem venesection improper.

In general, the pulse is smaller and harder in inflammation, in proportion as the system is affected; and hence we may, from its smallness, judge of the danger. In inflammation of the lungs, we have seldom, except in robust and plethoric people, a full pulse; at least, if the inflammation be very acute. In inflammation of the brain, the pulse is likewise hard, and seldom full; though the state of the pulse is not so often uniform in

phrenitis ; for great variations take place in this disease. In gastritis, the pulse is very small, and quick. The same is the case in inflammation of the small intestines ; but it is rather fuller, when the great intestines alone are affected, and inflammation in them is not so dangerous. In cuticular inflammation, the pulse is fuller, but, of consequence, proportionally slower.

If we are not to be misled by a small, neither are we to be deceived by a full pulse ; for this is often felt, even very near dissolution *. In these cases, the artery is contracting very feebly, and is approaching to the nature of a vein. In dangerous apoplexies, the pulse is

* In acute diseases, it is a very bad sign to find the pulse full, and the beat very frequent ; for this marks, that the artery is unable fully to contract : We feel a vibration, rather than a contraction.

likewise often full, from the diminished power of the artery.

WHEN the pulse is very weak, and very slow, we may infer, that the general action of the system is much diminished, and that syncope, or death, is at hand; for, immediately before death, we find a considerable interval betwixt the feeble contractions of the heart.

A SLOW pulse, conjoined with local pains, shows, that no inflammation is present, but that the sensation proceeds from a different cause, often a convulsive action of the part.

THE state of the stomach, and abdominal viscera, influences the circulation greatly, producing, very frequently, a remarkable slowness of the pulse.

DEVIATIONS, in the function of circulation, are not to be considered as diseases in themselves, unless they depend upon some local affection of the organs of circulation; and, therefore, we are not always to direct our remedies to the removal of these alterations alone. On the contrary, we more frequently attend to them, as marks, by which we may know what kind of action is going on. If, however, the diseased action be very much connected with the circulation, (as inflammation,) we attempt the cure by remedies directed to the vascular system, the state of which is one chief and dangerous symptom of the disease.

WE have several methods of affecting the vascular system; such as, cold, bleeding, sweating, stimulants, &c.; and these are to be employed with two views:

First, to restore the balance between the venous and arterial system, when this is destroyed; and, for this purpose, sweating is the best remedy which we can employ. Second, to obviate some particular conditions; such as, weakness, hardness, frequency, &c.; and, for this purpose, we must apply the appropriate remedies; such as, cordials, bleeding, &c.; or, if possible, remove the cause.

Of the Equilibrium of Action, and Sympathy.

HAVING proceeded thus far in the account of the living principle, and having mentioned, that it is diffused, in an equable degree, over the whole body*, I may next observe, that, in a

* Although I maintain, that the vital energy is diffused, in an equable manner, over the whole body; that is, each

state of health, the action of each part is proportioned to that of the rest, the whole acting equally. All the body is sympathetically connected together, and dependent, the one part upon the rest, constituting a general sympathy: But sometimes we find particular parts more intimately dependent upon each other, than upon the rest of the body, constituting a particular sympathy. Action cannot be greatly increased, in any one organ, without being diminished in some other; but certain parts are more apt to be affected, by the derangement of particular organs, than others; and it was the observance of this fact, which

part having as much, in proportion to its necessities, as another; yet I do not mean to say, that each part possesses absolutely the same quantity: The reverse is the case; but each part is, in health, as perfectly supplied with it as the rest, considered with regard to its own functions and demand.

gave foundation to the old and well-known doctrine of sympathy*, which was said to proceed, "tum ob communionem et similitudinem generis, tum ob viciniam †."

It may be thought, that this position,

* Many ridiculous explanations were given, of the consent of one part with another; such as, similarity of intimate structure, anastomosis of blood-vessels, connection of nerves, &c. The theory which Hippocrates had of sympathy, is to be found in his book, *De Locis in Homine*: "Corpus porro ipsum sibiipsum idem ac simile est, et ex iisdem compositum est. Similiter autem habet et parvas et magnas partes, itemque infernas ac supernas. Et, si quis minimam corporis partem acceptam male afficere velit, totum corpus affectionem sentiet, qualiscunque tandem ea fuerit; propterea quicquid tandem minima pars pertulerit, ad gentilitatem refert ac transfert, unaquæque ad suam, siue bonum siue malum id fuerit; et propterea, corpus et dolet et lætatur cum minima gente, quia in minima omnes insunt partes, et hæc ad gentiles sibiipsis singula transferunt, et omnia denunciant."

† Laurentii Opera, p. 323.

of action being diminished in one organ, by its increase, either in the rest, or in some other part, is contradicted, by the existence of general diseases, or actions, affecting the whole system: But, in them, we find, in the first place, that there is always some part more affected than the rest. This local affection is, sometimes, the first symptom, and affects the constitution, in a secondary way, either by the irritation which it produces, or by an extension of the specific action. At other times, the local affection is coeval with the general disease, and forms a part of the direct effect of the exciting cause which produced the derangement. In the first case, the general disease is called sympathetic; in the second, idiopathic. We observe, in the second place, that, as there is some part which is always more affected than the rest, so also is there some organ which has its action,

in consequence of this, diminished lower than that of the rest of the system, and, most commonly, lower than its natural standard. From the extensive sympathy of the stomach, with almost every part of the body, we find, that this most frequently suffers, and has its action diminished, in every disease, whether general or local, provided that the diseased action arises to any considerable degree. There are also other organs, which may, in like manner, suffer, from their association or connection with others which become diseased, as will be immediately explained. Thus, for instance, we see, in the general disease called puerperal fever, that the action of the breasts is diminished, by the increased inflammatory action of the uterus.

In consequence of this balance of ac-

tion*, or general connection of the system, a sudden pain, consequent to violent action of any particular part, will so weaken the rest, as to produce fainting, and, occasionally, death. But this dependence appears more evidently, in what may be called the smaller systems of the body, or those parts which seem to be more intimately connected with each other, than they are with the general system. Of this kind is the con-

* The theory of a balance, of any kind, existing in the system, was first, I believe, decidedly pointed out by the late Dr. Irvine, whose chemical knowledge has deservedly raised his name high among the philosophers of Europe: But he only imagined, that a balance of sensibility or sensation exists in the body, which is a doctrine very different from the present, which supposes a balance of action. The ancient and common doctrine of sympathy, was very different from this, which I have attempted to establish; because it was believed, that the part sympathizing became affected with a disease, similar, or nearly similar, to that of the part originally injured.

nection of the breasts with the uterus of the female; of the urethra with the testicles of the male; of the stomach with the liver; of the intestines with the stomach, and of this again with the brain; of the one extremity of the bone with the other; of the body of the muscle with its insertion; of the skin with the parts below it.

Of these smaller systems, or circles, I shall treat regularly; but, first, it may be proper to observe, that these are not only intimately connected with themselves, but also with the general system, an universal sympathy being thus established.

THAT there is a very intimate connection between the breasts and uterus, has been long known, but it has not

been very satisfactorily explained. Fallopius, and all the older authors, declare plainly, that the sympathy is produced by an anastomosis of vessels; Bartholin adding, that the child being born, the blood no longer goes to the uterus, but is directed to the breasts, and changed into milk. But none of all those who talk of this derivation assign any reasonable cause which may produce it.

IN pregnancy, and at the menstrual periods, the uterus is active; but, when the child is delivered, the action of the uterus subsides, whilst the breasts, in their turn, become active, and secrete milk. If, at this time, we should again produce action in the uterus, we diminish that of the breasts, and destroy the secretion of milk, as is well illustrated by the case of inflammation of the uterus, which is

incident to lying-in women*. When the uterus, at the cessation of the menses, ceases to be active, or to secrete, we often find, that the breasts have an action excited in them, becoming slowly inflamed, and assuming a cancerous disposition. The uterus and breasts seem to be a set of glands, balancing each other, in the system, one only being naturally active, or secreting properly, at a time; and, accordingly, we seldom, if ever, find, that, when the uterus yields the menstrual discharge, the milk is secreted in perfection, during the continuance of that discharge; nor do we ever find them both inflamed at the same time,

THE uterus has not only this connec-

* In puerperal fever, when the uterus becomes inflamed, the secretion of milk disappears, until the action of the uterus ceases. See the Anatomy of the Gravid Uterus, p. 73.

tion with the breasts, but it has also a very particular sympathy with the stomach, which again sympathises with the brain; and thus we see how a disorder of the uterus may induce an extensive series of affections, each dependent on the other*.

* When the uterus has its action increased, at the menstrual period, the stomach is often much affected, and, along with it, the brain, and whole nervous system, producing hysteria. There is, at this time, every symptom of weakened stomach; such as, vomiting, belching, and, not unfrequently, spasmodic contractions. This state of the stomach will, in its turn, affect the brain, in the same way as it does after a debauch, or in violent dyspepsia; that is to say, it will produce head-ache or dizziness. This affection of the head is not the immediate consequence of the action of the uterus, but depends upon the disease of the stomach, induced by the uterus. Thus we see that organs may come to suffer, by the derangement of a particular part, although they do not directly sympathise with that part. A recollection of this may be of use in investigating the nature of some complicated diseases.

THE uterus has been known, ever since the foundation of physic, to produce very extensive disease in the nervous system; and it is amusing to hear how this was explained. The disease, called "Suffocation of the Uterus," with many other hysterical ailments, were attributed to the swelling or choaking up of the uterus, by winds and vapours generated from the retention of the menses, or by the corruption of the semen, and putrefaction of the bad humours, which came there to be discharged; for this organ was considered by many as a common cloaca*. These "ventosities" being once generated, it was believed, that they mounted up to the stomach, the liver, and, at last, to the brain. The cure consisted in expelling

* "Cette partie est comme un cloaque ou sont envoyez tous les excrements du corps." *Ambrose Pare.*

these; and one of the remedies which was employed, for this purpose, was warm aromatic fumes, conveyed, by tubes, to the os uteri; for there was no safety, they imagined, until this vile stuff was discharged; this "occult odour," as Van Helmont calls it.

THE organs of generation, in the male, form likewise a little system, in which all the parts exhibit this sympathy with each other. They likewise give us a very good instance, of the association of action, or sympathy, in the common acceptation of that word.

SYMPATHY has been divided into the contiguous, where parts become affected from vicinity, and the remote, where a distant part becomes affected. It will be more conformable to the present doctrine, which I apprehend to be true, to

divide it into, first, the *sympathy of equilibrium*, in which one part is weakened, by the increased action of another; and, second, the *sympathy of association*, in which two parts act together, at the same time.

of distant Parts
 THE sympathy of association is produced suddenly, and for a short time: The sympathy of equilibrium is produced more slowly, and continues to operate for a much longer time.

It is curious enough, that most, or, at least, many of those organs, which seem to be connected by the sympathy of equilibrium, exhibit likewise more or less of the sympathy of association, when under the circumstances in which this can take place.

*THE sympathy of equilibrium is seen

in the effects of inflammation of the end of the urethra, on the testicle, which often diminishes its action, and produces a very disagreeable sensation of dullness; or, if this inflammation be suddenly diminished, the action of the testicle is as suddenly increased, and swelling takes place. The same is seen in the connection of the urethra with the bladder and prostate gland, as will be more fully mentioned in the dissertation on gonorrhœa. These parts, likewise, affect the stomach greatly, increased action in them weakening that organ much*. This is

* The effects of excessive venery, in producing dyspepsia, and, consequently, gout, is very well known. Unless this cause be removed, it is impossible for patients ever to recover from diseases of the stomach. Lord Chesterfield mentions, that when he consulted Boerrhave, that celebrated physician added, by way of a note to his prescription, "Venus rarius colatur." Letter cxxx.

seen in the effects of swelled testicle, or excessive venery, or inflamed bladder, or irritation of the bladder, from a stone; all which weaken the stomach, and produce dyspepsia. The same remark applies to the kidney; vomiting and flatulence being produced by nephritis.

THE sympathy of association, or an instance of sympathy, in the common acceptation of the word, is likewise seen in the connection betwixt the glans and testicles, in coition; but, for this purpose, the action in the glans must be sudden, and of short duration; for, if continued long, weakness of the testicles, or diminished action, is induced*. In

* It is on this principle, that, if emission does not take place quickly, in coitu, it either does not take place at all, or with difficulty. If the state of the glans be such, as to prevent a sudden and great action, in that part, no emission follows; and this is one cause of impotence.

those parts which exhibit this natural association of action, if the action of one part be suddenly, and for a short time, increased, the action of the sympathizing part will likewise be increased, as we see, in the instance already given, of coition, and likewise in paroxysms of the stone, in which the glans penis, after making water, becomes very painful: But, if the action be more slowly induced, and continued for a long time, then this association is set aside, by the stronger and more general principle of the equilibrium of action, and the sympathizing part is weakened. Hence, violent inflammation of the end of the urethra, produces a weakness and irritability of the bladder, dullness of the testicles, &c.

THERE is also an evident sympathy of equilibrium, betwixt the stomach and

lower tract of intestines, which two portions may be said, in general, to balance each other, in the abdomen. When the action of the intestines is increased, in diarrhoea, the stomach is often weakened, and the patient tormented with nausea. This will be cured, not so easily by medicines taken into the stomach, as by anodyne clysters, which will abate the action of the intestines. When the intestines are inflamed, as in strangulated hernia, vomiting is a never-failing attendant: When, again, the stomach is inflamed, the intestines are affected, and obstinate costiveness takes place*. Even

* It might be thought, that, as inflammation of the intestines produces nausea or vomiting, so gastritis ought to be attended, uniformly, with looseness. But it is to be remembered, that the same causes produce very different effects on different parts. What produces mortal sickness in one part of the alimentary canal, occasions violent pain

in hysterical affections of the stomach, the intestines are often deranged. Injections of cold water frequently relieve these affections of the stomach, by their action on the intestines.

THE liver and stomach are also connected with one another. When the liver is inflamed, or has its action increased, the stomach is weakened, and dyspeptic symptoms take place. When the stomach is weakened, as, for instance, by intoxication, then the action of the liver is increased, and a greater quantity than usual of bile is secreted. The same

in another; and the sensation and consequence of diminished action is different in different parts. Dyspepsia produces squeamishness in the stomach; but the same cause, affecting the intestines, occasions costiveness.

Gastritis may be accompanied with looseness; but, in this case, there must be some irritating cause in the intestines.

takes place in warm climates, where the stomach is much debilitated. If the liver has its action thus frequently increased, it assumes a species of inflammation, or becomes, as it is called, schirrus. This is exemplified in habitual dram drinkers, and in those who stay long in warm countries and use freedoms with the stomach. The liver likewise sympathises with the brain; for when this organ is injured, and its action much impaired, as in compression, inflammation and supuration have been often known to take place in the liver*.

BESIDES this connection of the stomach with the liver, it is also very intimately dependent on the brain, being weakened when the action of the brain is increased, as we see in inflammation

* Mem. de L'Acad. de Chirurg. Tom. III.

of that organ. The brain, again, is affected with pain, when the stomach is weakened by intoxication, or other causes; and this pain will be often relieved by slowly renewing the action of the stomach by such stimuli as are natural to it, such as small quantities of soups frequently repeated. A slight increase of action in the stomach, at least if not of a morbid kind, affects the brain so as to produce sleep, diminishing its action. This we see in the effects of a full meal, and even of a draught of warm water. The stomach likewise sympathises with the throat, squeamishness and anorexia being often produced by inflammation of the tonsils. This inflammation is frequently abated by restoring or increasing the action of the stomach. Hence the throat, in slight inflammation, is frequently easier after dinner: Hence, likewise, the effect of emetics in cynanche.

THE extremities of bones and muscles also sympathise in the same manner. When one end of a bone is inflamed, the action of the other is lessened, and pain is produced *; for a painful sensation may result both from increased and diminished action. When the tendon of a muscle is inflamed, the body of that muscle often is pained; and vice versa.

LASTLY, the external skin sympathises with the parts below it. If it be inflamed, as in erysipelas, the parts immediately beneath are weakened, or have their natural action diminished. If this inflammation affect the face or scalp, then the brain is injured, and head-ache, stupor, or delirium mite, supervene. If it attack the skin of the abdomen, then the abdo-

* To give only one example; in morbus coxarius, the knee is painful.

mainal viscera are affected, and we have vomiting and purging, or obstinate constiveness, according to circumstances, as explained in a note to a former part of the text. This is illustrated by the disease of children, which is called by the women the bowel hive, in which the skin is inflamed, as they suppose, from some morbid matter within;

If the internal parts be inflamed, the action of the surface is diminished; and, by increasing this action, we can lessen or remove the disease below, as we see daily proved by the good effects of blisters. When the stomach, intestines, or kidney, have been very irritable, I have known a sinapism act like a charm; and in the deep-seated inflammations of the breasts, bowels, or joints, we know of no better remedy, after the use of the lancet, than blisters. The utility of issues, in diseases

of the lungs, the liver, and the joints, is to be explained on the same principle. In these cases, we find, that issues do little good unless they be somewhat painful, or be in the state of healthy ulcers. An indolent flabby sore, however large the discharge (which is always thin, and accompanied with little action), does no good, but only adds to the misery of the patient. We may, however, err on the other hand, by making the issues too painful, or by keeping them active too long; for, after they have removed the inflammatory disease below, they will still operate on these parts, lessening their action, and preventing the healing process from going on properly. This is seen in cases of curvature of the spine, where, at first, the inflammation of the vertebra is diminished by the issues; but if they be kept long open after this is removed, they do harm. We often see the patient

recover rapidly, after his surgeon has healed the issue in despair, judging that it could do no farther service, but only increase the weakness of his patient.

It is a well-established fact, that when any particular action disappears suddenly from a part, it will often speedily affect that organ which sympathises most with the part which was originally diseased. This is best seen in the inflammatory action, which, as practical writers have well observed, occasionally disappears quickly from the part first affected, and then shows itself in some other*.

* In the cynanche parotidea, the testicles or breasts often swell in proportion as the inflammation leaves the parotid gland. There are many instances in which the increased action of the parotid gland, in mercurial salivation, has subsided suddenly, and affected the stomach with intolerable irritability. The cessation of the inflammatory action of the urethra in gonorrhoea, and its consequent ap-

FROM the united testimony of all these facts, I may certainly maintain the doctrine which I proposed to prove, and introduce it into pathological reasonings. In the whole of the animal economy, we discover marks of the wisdom of the Creator; but, perhaps, in no part of it more than in this, of the existence of the sympathy of equilibrium: For, if a large part of the system were to have its action much increased, and all the other parts to continue acting, in the same proportionate degree as formerly, the whole must be soon exhausted, (for increased action would require, for its support, an increased quantity of energy). But, upon this principle, when action is much increased in one part, it is, to a certain degree, diminished in some other. The general sum or degree

pearance in the testicles, has been already mentioned, and will afterwards be more fully considered.

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of action in the body, is thus less than it otherwise would be, and, consequently, the system suffers less.

Of the Actions of the Nervous Energy.

HAVING made these general observations upon the nervous system, I come now to consider, more particularly, its different operations or actions. These, we have seen, are always induced by agents, which are to be considered as external; and these agents are called stimuli. The action or operation which is produced, depends, first, upon the nature of the stimulus; and, second, upon the property of the nerve*.

* There are many nerves, which have, ab initio, a certain function or property allotted to them, which is excited by the application of some particular or specific stimulus. But, after this peculiar action of the nerve is fully esta-

EVERY state of the system is produced by an operation of the nervous energy; and this operation is called an action.

ALMOST every substance produces some change upon the system; and these changes may all be called diseases, if, by this term, we understand a condition of the nervous system, not entirely the same with the natural state,

It has been already mentioned, that the living principle, if not acted on, would exhibit no phenomena; and that, although it should be present in any body, we should still, were there no action produced, conclude that body to be dead.

It is not always necessary, for the performance of these actions, that the specific stimulus be applied. Light, for instance, is not always requisite, for the sensation or action of vision, nor air for hearing; the application of zinc and silver, &c. being capable of producing these.

The term life, in common language, is applied, not to the living principle, but to its evident operations or actions. These are produced by certain fixed and determinate agents, which act constantly, and produce, what is called, the healthy, or natural action, (or, in common language, life). If we apply other agents than those which are natural, we modify or change the action; and, in proportion as the new action differs from the natural one, so is it dangerous to the system. These actions may be considered as different varieties of life, if we use this term in its vulgar acceptation; but these varieties, or, at least, many of them, not being fitted to our frame, we cannot exist long with them, more than we could, were the specific life, or congeries of actions of a quadruped, to be excited in us by any magical power,

It must evidently appear difficult, to every one who thinks upon the subject, to say, how foreign agents operate on the living principle of man, or how a small particle of matter, taken from the bowels of the earth, should excite a dangerous and mortal action of the vital power of an animal. In order, in some degree, to explain this, I may observe, first, that no two inert bodies can act on each other; or, in other words, that matter alone cannot act on matter, unless it be possessed of some active power: Neither is it possible for an inert body to act on one possessed of this enlivening principle; for the very capability of producing or exciting action, implies activity. Unless, then, both agent and actor possess some property different from mere matter, or matter truly dead, no change can be produced. Were the sun to lose its active power, or attraction,

it could no longer act on any of the planets; and were any of the planets to lose their power, they could no longer be acted on by the sun, or by other planets. If, then, it be admitted, which none will deny, that action can only be produced in a body which is alive, and by an agent possessed of an active principle, it will follow, that no action can be excited in an animal, except by means of the active principle of the agent which immediately excites it.

I SHALL, secondly, observe, that, as the vital principle, in animals and vegetables, admits of modifications, in the different individuals with which it is connected, so also does the vital or active principle of common matter; and it is these modifications which produce the essential and characteristic qualities of the different individuals, or different

kinds of matter. Chemistry teaches us, that there are not many kinds of matter radically different; and, it is not extravagant to believe, that, were science improved, or, were the whole mystery of creation unfolded, we might find, that there was only one radical kind of matter, which, by its modification, yielded different products. The specific, or differential qualities of matter, never can be supposed to depend upon any cause, inseparably connected with mere matter, but must depend upon the operation of a distinct and active principle. We may mix different species of matter together, taken from the vegetable or mineral kingdoms; but we shall not make a new substance, unless the active principle operate, and become modified, converting the whole into a new individual.

In the third place, I remark, that a

modification of a cause must produce an alteration in the effect.

From these three observations, I think we may understand, first, how foreign agents are capable of acting on the body; and, second, why different agents should excite different actions.

I MAY farther observe, that it is only the attractive principle, or life of matter, which operates on animal life, exciting it to action; and it is only in so far as living animals, or vegetables, possess properties in common with common matter, that they can excite action in another animal. Hence, when applied to the body, or taken into the stomach, they can only excite the simple actions productive of the sensation of feeling: But, after the animals, or vegetables, die, that is to say, part with their specific life, and be-

come the same with common matter, then they can excite peculiar and varied actions; then, but not until then, can they be changed, and rendered useful as food, and not until then, do they ever act as medicines.

It is upon the principle now mentioned, of agents, or stimuli, acting only on the body, by means of their active principle, that we are to explain the influence of these larger masses of matter, the sun and moon, upon the human body. That these affect the body, both during health and disease, has been so fully admitted, by so many attentive physicians*, that I shall consider the fact as established, and requiring no farther evidence in this place.

* See the Works of Mead, and, more lately, the Observations of Jackson, Balfour, &c.

THE operation, or action, of the system, in the healthy state, can scarcely be described; because it comprehends and produces every circumstance connected with health; such as, sensibility, muscular contraction, absorption, nutrition, digestion, and all the other functions of the body. These operations, taken collectively, may give some idea of the natural or healthy action. This action is much too extensive and intricate to be described, or defined; but it may be understood, by observing the general condition of a healthy person.

THE presence of this action, seems also to be requisite for the support or renewal of the energy which produces it; for, if the action be suspended, or totally changed, the functions cease; all energy is lost, and death takes place. Whilst the action, then, depends upon

the power, the power depends, for its continuance, upon the action*. Hence, when agents capable of exciting an action, very different from the natural one, are applied, we may readily perceive, how weakness ought to be the

* We have seen, that the vitality of animals is received from common matter, the active principle of which is gradually changed, and rendered more perfect. It is from the life of the blood, that all energy is immediately derived, being, in the brain and nerves, elevated to the greatest degree of perfection. This is, undoubtedly, the effect of some action; for it is not done by any innate quality, inseparably connected with vitality itself; otherwise, we might find it raising itself to different degrees of perfection, in the very lowest orders of the creation. This action is not seated in the blood; otherwise, we should find the life more perfect than it is, in the blood; but it is to be found in the nervous system, which performs all the actions and operations of the body, by means of a living principle, which, by its operation, enables it to renew the energy, or power. The nerves alone cannot do this; for it implies an active operation, which they cannot perform without life.

consequence: On the contrary, if the natural action be gradually increased, and remain unchanged, strength will be produced *. If, however, the increase of action has been more sudden, and to a greater degree, we find, that it is changed in its nature, and is no longer healthy, as we see in inflammation, in which we have no production of strength, but, on the contrary, an expenditure of power. The same thing happens, when particular functions are increased in their action; such as, muscular motion, secretion, &c.

THE nervous system has its energy

* If, by any means, the energy could be increased, without a previous increase of action, (which, however, is impossible,) we should, in all probability, have an immediate increase of action. Increase of energy, and increase of natural action, singly, ought to produce the same effect.

supported, and its healthy actions excited, by arterial blood, which may, therefore, be called a natural stimulus. Heat, air, and food, are likewise necessary stimuli; but these all act, either by preparing the blood, or imitating its operation. Food and air give to the blood its most valuable qualities; and heat, applied externally, only co-operates with that fluid, which produces it in a certain quantity, by the action of the living system.

WHEN other agents operate on the system, a different state from that produced by the blood, is induced in the body. Wine, opium, contagions, mercury, &c. being all capable of operating on the system, produce an action, which, of necessity, must be different from the natural action, in as much as these agents differ from the natural agent.

NEW agents sometimes appear to increase the natural action; but this, it is evident, they never can do, without changing or modifying it in some respect*; and, therefore, the opinion, that

* No agent can excite an action perfectly similar to the natural one, unless it be a stimulus, which is habitually present, such as, arterial blood and heat. Electricity appears to increase the natural action, or whatever action is going on at the time of its application, in the same way with heat; but we cannot call electricity a new agent; for it certainly operates, habitually, on our system, although, as yet, we are much in the dark respecting it.

Those agents which are natural to the system, are found to increase every action which is going on, whether healthy or diseased. Hence, blood and heat will support, not only the natural action, but also any other which has been induced.

This may explain to us the use of heat in medicine, and may also inform us, what effects we are to expect from it. In warm climates, some functions, or parts of the natural action, are increased, beyond that relation which ought to subsist betwixt them and the power, and weakness is produced. All the secretory actions are increased, at least, such as are not incompatible with each other;

they produce diseases, consisting entirely of different degrees of strength, or natural action, is absurd. When any stimulus has been applied to a part, so as to produce inflammation, it has been supposed merely to increase the vigour of the part, or, in the language of Dr. Brown, to increase its sthenic diathesis. But the whole series of symptoms, in that disease, show, that a new action is produced, differing very much from the natural one, both in its progress and consequences, as will be evidently seen, when we come after-

such as the secretion of urine, and sweat, which cannot both be increased in quantity at the same time. All morbid actions are increased; and hence the danger of diseases in warm climates. The fever is violent, and runs its course rapidly: The action in ulcers is far beyond the power, and the destruction is great: The contagion of dysentery acts powerfully, and a few hours decide the fate: Blood, like heat, increases actions; and hence the truth of the old observation, "That full-blooded people bear disease worse than the spare."

wards more fully to examine it. The variolous matter, again, at the same time that it induces the inflammatory action, modifies it, and, in a very striking manner, changes its nature.

Some actions appear to arise without any evident cause, or to be repeated, by what is called habit; but, in order that this may take place, it is necessary, first, that the action have been, at some former period, strongly excited, or long continued, or frequently repeated: Second, that either some stimulus be applied, which has been frequently applied during the former continuance of the action, and which had been accustomed to increase it; or, that some stimulus be applied, which, in its effects, bears a resemblance to some part of the former diseased action, which is thus renewed. Thus, if a person has once had an ague,

he is apt to have a return of it, whenever he is exposed to much cold, which induces a state similar to the former cold fit.

IN all morbid actions, we have three periods to attend to:

FIRST, The period of formation, in which the animal is weakened, by the diminution of the natural action, or functions, during the time that the new action takes to form; for diseased actions never take place suddenly, (unless the exciting cause be very powerful, and applied only to a particular part, producing local disease), but a certain time is required for their formation. The weakness induced in this way, will be observable in every general action, and even in those which, when fully formed, are called inflammatory. The symptoms

which take place, during the formation of an action, are lassitude, anorexia, coldness, head-ache, and thirst. These always occur, and precede actions, the most dissimilar one to the other.

SECOND, The period in which the action exists in perfection, and fully formed, marked by the peculiar characters of the action; such as, heat, pain, and redness, in inflammation; eruptions, in the exanthematæ; peculiar indescribable condition in typhus, &c.

THIRD, The termination. All new actions terminate by a secretion. In the inflammatory action, we have either a secretion of matter, similar, or nearly similar, to the natural substance of the part, producing adhesion, or resolution, as it is called; or a secretion of a fluid,

called pus, serum *, &c. In many other actions, however, we have no new secretion formed, but only an augmentation, and perhaps, slight change, of some natural and accustomed discharge; such as, sweat, urine, or, occasionally, the intestinal mucus. These discharges, or secretions, are sometimes in small quantity; but, at other times, they are more considerable and evident. By the attentive ancients, they were called critical, as they were often seen to occur in the end of the disease.

ALTHOUGH all actions terminate in a secretion, yet it does not follow, that, whenever the secretion appears, disease is

* Pus is the most common secretion, terminating inflammation; but it may also end in a secretion of thin fluid, like serum, producing a dropsy of the affected part. This is too frequently fatally seen in the head and chest.

to end. The reverse is too often the case; for, in many species of inflammation, the secretion continues permanent, unless we interrupt it by art. In all acute diseases, however, or in those which are called febrile, the secretion does not continue permanent; and, in all eruptive actions belonging to this class, the action terminates, whenever this secretion is completed; and the patient is then subject only to the weakness which the action may have induced, and to the effects which the eruption, considered as simple ulcers, may now produce. This is seen in the small-pox, chicken-pox, &c.*

ACTIONS are only known and distin-

* I have seen the measles appear, before the pustules of the chicken-pox were quite gone, which could not have happened, unless the general disease, or peculiar action, had disappeared, when the secretion took place.

guished by their effects; and many of these are of such a nature, as not to be cognisable by the senses; such as, the peculiar or specific state of the body, in typhus fever, small-pox, &c. The precise nature of these conditions, can neither be described nor understood; because they cannot be brought under the examination of any of our senses. Some have, therefore, denied their existence altogether, or have not perceived it.

In almost every system of nosology, they have been entirely overlooked, the classification being founded upon such general and sensible deviations, as occur in every action, over and above the peculiar condition; such as, affection of the circulation, pains, eruptions, &c.

SOME actions are confined to a particular part of the body, whilst others af-

fect the whole system ; and, therefore, nosologists have uniformly separated these diseases from each other ; and, at first sight, we might conceive, that the primary and great division of diseases might be taken from this source. But, by maturer consideration, we shall find that the distinction is erroneous ; because there is no local disease whatever, which, if either increased in degree, or continued for a long time, will not affect the constitution, and induce a general ailment. On the other hand, there is no action which affects every part of the body equally ; and, therefore, there is no general disease without a local one ; or, in other words, there is always some part of the body, in every disease, more affected than the rest. In the exanthematæ, the skin is most affected ; in fevers, strictly so called, the head is generally most affected, although sometimes the lungs or

abdominal viscera suffer most. Of all the parts of the body, however, the brain generally is affected in the greatest degree, unless the disease be induced by some cause acting locally on other parts; but, even in this case, if the disease be violent, an affection of the head is superadded to the other local disease. This is exemplified, in the case of those who die after wounds or operations; in which event, the brain is commonly found turgid, and the patient, not unfrequently, is affected with coma before death. In certain diseases, we observe a series of aptitudes of the different parts of the body to be affected, as will afterwards be particularly illustrated in the venereal disease. In all actions, the least sensible parts suffer latest. This we see in the case of the bones, tendons, and cartilages.

ACTIONS produce different symptoms,

according as they are extended over the body. Such as affect the whole system, produce undefinable uneasiness, frequency of pulse, heat, and the other symptoms of what is called fever. But, when action appears in one part more than the rest, as it always does, that part is affected with what we call pain; and, if the action be still more increased in it, we have a species of inflammation induced. This is illustrated by every disease which we know of; for, in common fever, in small-pox, and every specific action, we find inflammation produced, whenever action becomes much concentrated in any part*.

* Inflammation in a part, is intimately dependent on the state of the vessels. All actions, which produce perceptible disease, affect the vessels, making them contract more or less frequently, and more or less strongly. We may, therefore, see how any action, when greatly increased in a part, may induce inflammation.

INSTEAD of adhering to the more established modes of classing diseases, it will better answer the present purpose, to divide actions into the six following classes*.

* This arrangement will, it is true, bring together diseases, which have often been far separated; and is likewise very imperfect, because no more than an outline of the classification can be given here. The minuter subdivisions, arising from the action being general or local, and from the function, chiefly impaired, or other circumstances, cannot be noticed in this sketch. If these were inserted, (which would take more room than can be properly spared to it,) many of the imperfections and apparent inaccuracies would disappear; but no system of nosology ever has, and, until our knowledge be increased, ever can be free from fault. As for the circumstance, of bringing together diseases or actions formerly separated, I have only to remark, that the same licence ought to be allowed for uniting them, as for separating them, both proceeding on arbitrary or assumed principles. In this arrangement, the actions are classed, not altogether according to their cause, but chiefly according to their evident effects or symptoms, which is the most useful way; the object of medicine as yet being almost totally confined to the removal of symptoms. To

CLASS I.

A. Naturales.

ALTERATIONS in the performance of the natural action of a part of the body, or of the whole system, but not to such a degree, as materially to change its nature, or render it new*.

Order 1. IMPERFECTÆ.—A diminution, interruption, or irregularity of the

comprehend all the diseases of the human body, another class, consisting of actions of the mind, ought to be added.

• We shall afterwards find, when we come to consider inflammation, that if the whole natural action of a part be much increased, it becomes changed in its nature and effects: But the present class comprehends these changes only, which take place to such a degree, as not to alter the nature, or destroy the characteristic marks, of the natural action.

performance of some part, or the whole of the natural action *.

Order 2. ACCRESCENTES.—Some part of the natural action morbidly increased, without being materially changed in its nature †.

Order 3. INEQUALES.—A loss of balance betwixt some part of the natural action ‡.

* This order may be subdivided, according as it affects the different functions, &c.; and comprehends spasm, epilepsy, palpitation, asthma, dyspepsia, cholic, chlorosis, torpor from cold, &c.

† This will comprehend, cholera, diarrhoea, menorrhagia, &c.

‡ This comprehends the different varieties of dropsy. In this disease, the secretion and absorption do not balance each other.

performance of some part, or the whole
of the natural action *

CLASS II.

Order 2. ACCIDENTES.—Some part

of the natural action morbidly increased,
without being changed in its

A. Transposita.

A TRANSPOSITION of the natural ac-
tion of some part of the body to another
part, which, in health, possesses a differ-
ent action.

Order 1. FORMANTES.—A transposi-
tion of the action which forms the
part *.

* When the muscle-forming action is lost in the arteries,
and membrane is produced in its place, aneurism is the
consequence. When the action of forming bone is trans-
ferred to the heart, a very serious disease takes place.
When the action of the vessels of the tunica sclerotica
is transferred to the crystalline lens, cataract is pro-
duced.

Order 2. SECERNENTES.—A transposition of some secretory action *.

Order 3. SYMPATHETICÆ.—Actions transferred, by sympathy, from the diseased part to one which was formerly healthy †.

CLASS III.

A. Similes.

Actions which, when analysed, are found to bear a resemblance to the natural action, which is increased to such

* There are instances recorded, of the purulent secretion being transferred to some part which formerly was sound. There are many cases, where the menstrual discharge has come from different parts of the body.

† This order is founded on the doctrine of the sympathy of equilibrium, which has been already explained.

a degree, as to become changed in its nature *.

Order 1. INFLAMMATÆ.—Actions producing heat, redness, pain, and more or less swelling, in some particular organ, often attended with pyrexia †.

Order 2. STIMULANTES.—A general increase of action, (without such a local affection as to produce true inflammation in the part,) marked by frequency of pulse, heat of the skin, thirst, and pain or confusion in the head †.

* The change of the nature of an action, from a change of its degree, will be afterwards illustrated, in the dissertation on inflammation.

† This order comprehends the phlegmasiæ of nosologists.

† This comprehends the slight febrile attack called ephemeræ; the action induced by wine, spirits, hartshorn,

Order 3. SANGUINANTES. — A discharge of blood from the vessels of a part, without any artificial wound, accompanied with a general action of the system *.

Order 4. TONICÆ. — Actions consisting in an increased contractile power, nearly, though not entirely, similar to the natural action †.

&c. In these there is always some part more affected than the rest; but this superior affection must not be to such a degree, as to produce inflammation; otherwise the action will belong to the order inflammation.

* This comprehends the order hemorrhagia of nosologists. The subdivisions are founded on the part affected. Apoplexy belongs to this order, being produced by a hemorrhagic action in the brain.

† This is entirely confined to the effects of those agents called medicines; such as, alum, galls, bark, bitters, &c. These are often used to strengthen the body; because they excite an action nearly similar to the natural one; and, if

Order 5. HECTICÆ.—Frequent pulse, weakness, sweats, and purging, heat of the skin, flushed face, thirst, wasting of the body, without any specific action*.

Order 6. MECHANICÆ.—General action, dependent chiefly on some local cause, acting mechanically†.

CLASS IV.

A. Diffimiles.

ACTIONS very dissimilar to the na-

given gradually, they do in the end in reality increase the healthy action, by having for so long induced one in an increased degree, which nearly resembles it.

* The different species of phthisis, atrophy, &c. are to be placed here.

† Of this kind is jaundice, proceeding from biliary obstructions.

tural action, and which may be called specific*.

Order 1. INTERMITTENTES.—Actions which alternately disappear and return, or remit and increase, for a certain time†.

Order 2. TYPHOIDES.—Great prostration of strength; pulse frequent, sometimes full at first, but always small, after the disease has continued for a short time; pain in the head, with disturb-

* These are, of all actions, the most dangerous, on account of the great and rapid weakness which most of them induce. Some call the agents productive of these, sedatives; but the name is improper, for they are very far from soothing. *Agentes dissimiles*, is, from the poverty of language, the best I can fix on.

† Such as the different varieties of intermitting fevers.

ance of the mental faculties; urgent thirst, with foul tongue *.

Order 3. **VENENOSÆ.**—Great weakness, often attended with eruptions; or other local affections, produced by the application of what are called poisons †.

CLASS V.

A. Mixta.

ACTIONS which are of a mixed nature, resembling in part the class Similes, but having also some peculiar or dissimilar action united to this.

* Comprehends typhus, plague, cynanche maligna, the disease produced by the application of putrid matter to the body, &c.

† The bite of many snakes, the effects of lead, laurel, &c.

Order 1. ERUPTURÆ.—Actions producing numerous inflammations of the surface, combined with a specific action, often ending in ulceration*.

Order 2. IMMUNDÆ.—Actions consisting in specific inflammation, not necessarily confined to the surface, and generally ending in ulceration†.

Order 3. GLANDULARES.—Specific actions, producing a change in the quality and appearance of some natural secretion, which is, at the same time, generally increased in quantity‡.

* Such as small-pox, measles, scarlatina, cow-pox, &c.

† Such as syphilis, cancer, elephantiasis, frambesia, phagedena, &c.

‡ Gonorrhœa belongs to this order.

Order 4. ULCERANTES.—Actions consisting in simple ulceration of a part, without any specific condition being conjoined*.

Order 5. CONNATÆ.—Morbid actions which are received at conception†.

Order 6. NARCOTICÆ.—Actions producing frequency of pulse, stupor, or sleep, with a disturbance of the imagination, and an inflammatory or hemorrhagic action of the brain, if excited to a sufficient degree‡.

* This order comprehends ulcers, succeeding to simple inflammation, which may properly enough be placed under the class *Mixtæ*, as the granulating action is a natural one, and the purulent action an unnatural one.

† Such as scrophula.

‡ Such as the actions of opium, hyocyamus, belladonna, &c.

Order 7. DIMINUTÆ.—The natural action chronically impaired, and some peculiar or specific action conjoined *.

Order 8. ADAUCTÆ.—An increase of some function, or part of the natural action, conjoined with some specific condition †.

Order 9. IRRITATÆ.—Increased and specific actions of the system, productive of local inflammation, if excited to a sufficient degree ‡.

* Such as febrilis.

† Pertussis, diabetes, &c.

‡ This differs both from the order *Inflammatæ* and the order *Stimulantæ*, by having a specific action conjoined with the general or local increase. It comprehends the actions of mercury, arsenic, copper, nitrous acid, &c.

CLASS VI.

A. Mentales.

MORBID conditions, seated either entirely in the mind, or operating on the body, through the influence of the mind, or on the mind, through the influence of the body.

Order 1. IDIOPATHICÆ.—Conditions consisting entirely in some mental derangement, without any considerable alterations in any of the functions of the animal.

Order 2. CORPOREÆ.—Alterations in the functions of the body, in consequence of some morbid operation of the mind.

Order 3. SYMPTOMATIC.—An affection of the mind, dependent on some disease of the body.

EVERY new or morbid action has naturally a certain course which it is inclined to run, or a certain series of symptoms or effects which must be produced, before it can be removed. When this course is accomplished, and the action has become complete, many of them disappear, and the natural action returns in perfection. This is illustrated by the action of wine, of common inflammation, of mercury, and of typhus fever. Others, as, for instance, intermitting fevers, having run one course, begin another, exhibiting a series of alternations betwixt health and disease. In syphilis, again, and some other diseases,

we find, that the action, when completed and made perfect, continues in that state without diminishing or disappearing.

By a knowledge of the facts already mentioned, we cure diseases, or remove dangerous actions. Certain actions, we have seen, disappear spontaneously, after having run their course: These we may, therefore, either altogether neglect, or, if this be imprudent, on account of their violence, we may attempt to make them run their course more speedily. When a part becomes inflamed, we find, that the symptoms continue increasing for a time, and then lessen, leaving the part either healthy, or in possession of another action, called the purulent. In this disease, then, we have an augmentation, an acmé, and a decline. When we attempt to diminish this action, we make that pe-

riod, in which we begin our treatment, the acmé, and the subsequent one the decline. In this case, it is often, though not always, comparatively speaking, of little consequence, whether we endeavour, by art, to complete the action speedily, or allow it to follow its course more extensively and tediously. But, in the typhus fever, the danger is always increasing, in proportion to the duration of the action; and, therefore, we ought, if possible, to complete it speedily. This we endeavour to do, in the very beginning, by an emetic, which, inducing the hot and sweating stages, often terminates the action.

THERE are other actions, however, which, we have seen, have no tendency to disappear, after all the stages are gone through. Of this kind, amongst many others, are intermittent fever and syphi-

lis. In these diseases, then, we must unavoidably follow, in every instance, that course, which, in inflammation, we may or may not pursue, as circumstances direct; namely, diminish the morbid action, by artificially restoring the natural one. In inflammation of strong parts, we might, by induction, discover the method of restoring health; for, if the disease consists in the natural action, increased to such a morbid degree as to change its nature, it is plain, that whatever would, in health, diminish the natural action, must here be of service. But, in the cure of the diseased actions at present under consideration, we can derive no such assistance from reasoning or judgment, because we are not so well acquainted with the nature of these actions. We have, accordingly, been altogether indebted to empiricism for a cure; but now, that the remedies are discover-

ed, we can ascertain the principle on which we proceed. In these diseases, it is impossible to restore directly the natural action; because the morbid one will not yield to it. We are, therefore, obliged to destroy the diseased action, by inducing another which is able to displace it, in the same way as it had removed the natural one. But this is not all which must be done; for we should still have only exchanged one disease for another, unless we had been careful to remove the first and obstinate diseased action, by another which would disappear, after having run its course, and allow the natural one again to appear*.

* In the cure of diseases, we ought not only to attempt removing the morbid action, by inducing such another general condition as shall answer our intention; but also, to attend to the removal of particular symptoms of the action, which will much co-operate with our general plan. In those actions, which we cannot yet cure by general re-

To apply this to syphilis;—it may be observed, that the mercurial action is as dissimilar to the venereal action, as this last was to the natural one; and, therefore, will remove it in the same way, and exactly on the same principle, on which the venereal action had taken place of the natural one. This being done, the patient is cured of one disease, but still labours under another, namely, the mercurial action. When this subsides, he is well. In the same way, bark, arsenic, &c. cure agues.

medics, we are confined entirely to this removal of symptoms; and a proper interference, in this respect, by the application of such remedies as shall do so, without, at the same time, tending to increase the morbid action, considered as a whole, requires the greatest discernment of the physician. In fevers, and many other diseases, people are much weakened; but he who should, from the beginning, attempt to obviate this by wine, would find the general action much increased by it, and his patient rendered worse.

UNFORTUNATELY, we are not able practically to apply this doctrine to the cure of many diseases; but this inability results not from any fault of the doctrine itself, but from our own ignorance of the nature of various actions, which prevents our opposing one to another with success *. Antimony has, by some, been proposed for removing the typhus action, ipecua for removing the cancerous

* It is a great loss to medicine, that distinctions have carefully been made betwixt what are called diseases, and what are called remedies. Do not the agents called medicines, and those which produce what we call disease, act all on the same principle? Do not both classes produce diseases, or unnatural actions? Might we not sometimes derive benefit from the actions which we call diseases, and which, in this case, we should find to be useful remedies? This has, in part, been admitted by many, who have wrote on the good effects of fevers in removing other diseases. It would, however, be requisite, that we should never induce a more dangerous action, in order to destroy one less.

disease, whilst the scrophula has been promised to be cured by the muriated barytes, and the small-pox to be prevented by mercury. But melancholy experience testifies the inefficacy of all these proposals, and the impossibility, as yet, of inducing an action capable of displacing these terrible diseases.

To conclude these observations, I may remark, that, although we may remove one action, by inducing another, yet this cannot be done, until the first has gone through all the essential stages to become perfect. Thus, mercury will not cure the venereal action, until inflammation, which is essential to the perfection of that action, has taken place. The typhus action cannot be removed, without sweating, or moisture on the surface, or some other secretion. The natural action, being always at its acmé,

or always complete, can be removed at any time; and the same may be said of the inflammatory.

Of the different Systems of Pathology.

From what has been said, it may appear, that we are to ascribe both the health and disease of an animal, to the operation of the living principle. Until within these few years, however, physicians have been too apt to imagine, that the diseases of man were similar to the changes induced on common matter, referring them entirely either to an augmentation or diminution of his fluids, or to a depravation of the humours.

THE different fluids of the body, were all divided, by the ancients, into the natural, the secondary, and the unnatural

humours. The *natural* humours, they said, were four in number: First, the phlegm, or pituita, which was prepared from cold and crude aliment, and in greatest abundance in old age, or the winter season, when the low degree of heat favoured its production. This pituita was formed in the brain, from whence it descended, to lubricate the joints, and dilute the blood: It nourished and supported the brain, and the cold parts of the body*. Second, the choler, or yellow bile, which was prepared in the liver: It was of a very hot and fiery nature; and, therefore, nourished the hot parts, at the same time that it corrected

* The different parts of the body were supposed to be either hot or cold, dry or humid. The brain was one of the cold parts, and was supposed, by Aristotle, to moderate the heat of the heart. Aristot. de Part. Anim. cap. vii. lib. 2,

the pituita, and purged the intestines. Third, the atra bilis, or melancholic humour: This was prepared in the spleen, which it nourished, as well as the drier parts of the body; it likewise promoted appetite. Fourth, the blood, which was prepared in the liver, from whence it was sent to all the different parts of the body, going out by day to the extremities, and returning by night to the more noble parts *.

THESE humours were supposed to operate more at one time than another, or to reign alternately; and, upon this conjecture, they explained, why certain dis-

• "Mundus quatuor ex elementis consistit, igne, aere, terra, et aqua: calido videlicet humido, frigido, et sicco. "Isdem ex elementis quatuor totidemque humoribus et homo consistit; sanguine scilicet, pituita, flava, et atra bili. Et sanguis quidem aeri, pituita aquae, flava autem bili igni, atra vero terre simulatur. Sanguis enim gustu

eases were worse at particular hours; the humour which produced them being then in its greatest force. The blood reigned from three o'clock in the morning until nine; the choler, from nine in the morning until three o'clock in the afternoon; the black bile, from this hour until nine in the evening; and the pituita, from nine until the blood began again its reign.

THE *secondary* humours were the invention of the Arabians, and were said by them to be the different steps toward

"dulcis est; pituita, falsa; flava bilis, amara; atra vero
 "alacetola, et flavescens. Sanguis autem locus, et spiritus
 "in corde est. A dextris quidem ejus sanguis, a sinistris
 "vero, spiritus consistit. Flava bilis in jecinore; atra in
 "liene; pituita quidem in cerebro, locus. Sanguis autem
 "calidus et humidus; pituita frigida et humida; flava bilis,
 "calida et sicca; atra vero sicca et frigida."

Hippocr. de Hum. Stru. ad Perdicam, &c.

nourishment: They were furnished by the blood, when it came to the part which was to be nourished.

THE *unnatural* humours were those which were perverted and diseased; and then, whatever might have been their former quality, they became hot. The blood* and melancholy corrupted only in the veins; the other two humours corrupted out of the vessels.

THESE humours were supposed to possess different qualities, which they communicated to the body, and upon which depended the peculiar properties of the body, considered either as a whole or a part. These states were called condi-

When the blood corrupted in its thicker part, it turned into melancholy; but when its thinner part was in fault, then it became choler.

tions, or temperaments, or constitutions; terms which are still retained, and meant to express the peculiar habit of body; as, strong, weak, scrophulous, &c. *

THE peripatetics, by the term temperament, or temperies, meant the condition of the body, with regard to the proportion of elements which it contained. The blood was said to be hot and moist; melancholy, cold and dry; choler, hot and dry; phlegm, cold and moist. According, then, as these humours preponderated, the body was said to possess a cold, hot, dry, or moist quality, condition, or temperament: And as these

* Instead of adhering to the old names, which depended upon the ancient theories of physic, practitioners have substituted a variety of new ones, corresponding to their own opinions; such as, phlogistic, catartic, splanic, asthenic, irritable, &c.

states were produced by the presence of the humours, physicians at last came to name the temperament, from the humour which produced it, instead of the quality which it imparted. Thus, we had the sanguineous, choleric (or bilious), melancholic (or atrabillan), and phlegmatic (or pituitous) temperaments, with many admixtures of each other, as, for instance, the sanguineo-choleric, &c.

WHEN the doctrines of the ancients came to be more fully commented on, the temperaments were more minutely subdivided and explained. The temperies bona consisted, in a due proportion, of all the qualities capable of being possessed by a body; such as, heat, cold, dryness, moisture, density, rarity, hardness, softness, viscosity, volatility, &c. The temperies was called moderate, when the qualities were of a moderate degree; im-

moderate, when they went beyond moderation. It was called total, when it affected the whole body; and this, again, was divided into the sanguineous, melancholic, bilious, and pituitous, according as these humours predominated. It was called partial, when the condition of different parts was considered individually. Thus, the brain was cold and moist; the heart, hot and moist; the bone, dry and cold; and a regular gradation, or series of changes, was established betwixt these, consisting of parts which possessed these qualities in an intermediate degree; the cartilage, for instance, was not so dry or cold as the bone, &c. It was called native, when it was received at conception; communicated, or unnatural, when changed after birth: And the chief causes which induced these changes, were age, the season of the year, climate, and habits. It was called permanent, when

it depended on the formation of the part; temporary, when it depended on the fluids.

THE intemperies, or bad temperies*, was divided into the manifest and occult. The manifest was either simple, when only one quality was morbidly increased, producing the warm, dry, or cold intemperies, for example; or complex, when more than one was in fault, producing the dry and hot intemperies, &c. The occult was produced by some hidden vice; such as, poison, contagion, &c.

BESIDES the natural humours, upon which the temperaments depended, and

* "Bona temperies est pars sanitatis, quæ in qualitatum convenienti constitutione consistit." Intemperies est morbus, qui in qualitatum copiosis inconvenientis consistit." *Regii Lib. Med. p. 5. c. 24.*

which were the cause of most diseases, the ancients likewise admitted the existence and operation of three different spirits, the natural, the vital, and the animal; and also the same number of faculties, called by the same name, which were the efficient causes of the different actions, in the performance of which the spirits were the instruments.

The natural spirit was supposed to be some fine exhalation from good blood, or some very delicate substance, prepared in the liver, from the blood and air*. This was the thickest and poorest of all the spirits, and was contained in the veins: It was the source of nutrition,

* Every spirit was supposed to be formed from the blood, the thickest parts forming the lowest kind of spirit. These spirits were called the vehicles, through which the different faculties operated.

and conducted the blood and natural faculty to all the different parts of the body. Some physicians, from considering, that no air could reach the liver, or, if it did, that there were no cavities in it, to form the natural spirit, doubted of its existence, and were confirmed in their scepticism, by observing, that there were no ducts leading from the liver capable of conveying it away; for they could not believe, that the thin coats of the veins could contain it. These difficulties, however, were readily overcome; for, as Hippocrates had declared, that "*omne corpus transpirabile est et transfluxile*," it followed, that the air might reach the liver, through the diaphragm; and as this spirit was thick, it followed, that the veins might contain it; and, being slowly produced, that no cavity was requisite for its formation.

THE vital spirit was prepared in the left side of the heart, from air and blood; and it was this union which produced the pulse. Physicians readily explained, how the air, taken in by inspiration, was prepared in the lungs, and conveyed, by the arteria venosa, or pulmonary vein, to the left auricle of the heart: But they found it more difficult, to settle the controversies which arose concerning the way in which the blood reached that cavity. According to Galen, the blood underwent some attenuation and preparatory change in the right side, whence part was sent, by the pulmonary artery, to nourish the lungs; while the rest was transmitted, through small foramina in the septum, to the left side. Columbus denied these pores to exist, and maintained, that the blood went from the one side to the other, by the circulation, which is now admitted and

established as a fact. Botallus invented a particular duct for this purpose; whilst Ulmus laughed at all these conjectures, and taught, that the blood underwent its preparatory change in the spleen, from which, by means of the aorta, it reached the left side of the heart. The blood and the air having, then, by some means or other, got together, they formed the vital spirit, which was contained in the arteries, where it could be felt bounding and jumbling, and by which it was conveyed to every part of the body, vivifying and preserving those parts which had been already formed by the natural spirit. " It maintains the heat, " (says Laurentius), brings out whatever " is lurking, and recruits the exhaust- " ed. It shines by its own light, and " displays itself in every part of the " theatre of the human body; and, be- " ing diffused over it, every part rejoices,

“and appears with a rosy colour. When
 “destroyed or intercepted, the whole
 “shivers, becomes pale, and dies*.”

THE animal spirit was the finest of all,
 and could not be confined within the
 coarser vessels. It was supposed, for a
 long time, to be prepared in the anterior
 ventricles of the brain, from the vital
 spirit, which ascended by the carotid
 and cervical arteries, and the air which
 was taken in by the nostrils during re-
 spiration. That this was the case was
 considered to be proved; because whe-
 ther the carotid were tied, or the breath
 of the nostrils stopped, the same effect,
 namely, apoplexy, was produced, the
 generation of this spirit being, in both
 instances, equally checked. When the
 circulation of the blood was discovered,

* Lamentii Opera, p. 569.

and the arteries were found to be full of arterial blood, then this doctrine of the ancients was new-modelled. The arterial blood, which was full of spirit, was sent, by the vessels, to the brain, where its watery part was separated, and passed off by the pituitary gland, whilst its spirit, or finer part, formed the animal spirit*.

Some denied the existence of this spirit, and thought that the vital spirit was sufficient for the operation of the body. Amongst these was Argenterius, who accused Galen of inaccuracy and contradiction; because, in one place, he attributes the generation of this spirit to the blood; in another, to the air; and in a third, to the vital spirit, which was said to form it, at one place, in the anterior

* De le boe Sylvius Opera Médica, p. 20.

ventricles; at another, in the plexus, or substance of the brain. But Laurentius* undertook to do away all these objections, and reconcile the apparent contradictions, by observing, that as the blood was necessary for the production of the vital spirit, and this spirit and air necessary for the generation of the *spiritus animalis*; therefore, all the three might properly be mentioned by Galen; and as for the objection, on account of the different places in which it was said to be produced, this also was a quibble; because it was prepared in the plexus and anterior ventricles, refined in

* Laurent. Opera Omnia, p. 652.—This author was particularly angry at Argenterius, because he had denied, that the fluid which came down the nose, was the peculiar excrement of the brain, but was generated in the liver. “*Me-hercule, (says he), in doctrina Argenterii nullus est infundibuli, et glandulæ pituitarie in cerebro temperatissimi usus.*” P. 664.

the third ventricle, perfected in the fourth, and diffused finally through all the substance of the brain and nerves.

THIS spirit, says Van Helmont, is the impetum faciens of Hippocrates, which holds the key of life in its hand. In the brain, it produced what are called the internal senses; when carried out of it by the nerves, it was the cause of motion, and the external senses. It has been already mentioned, that it was equivalent to the nervous energy of the modern schools.

UPON these humours and spirits, then, did the ancients found their system of physic*. Obstruction to the free motion of the animal spirit, produced pal-

* Disease, said they, is produced, by either a bad temperies, or by malformation of a part.

fies, apoplexies, and convulsions; whilst, when the vital spirit was affected, the heat of the parts, and their life, could no longer be supported, and mortification took place. A redundancy of blood produced phlegmon: The pituita caused dropfy; or, when the blood was full of it, from "multiplied crudities," then it fell upon the joints, and swelled them: The cholera produced jaundice, dysentery, and erysipelas; whilst the atra bilis, or melancholic humour, caused cancers; and, by "its fuliginous vapours ascending to the brain," brought on many disorders. These diseases were produced chiefly by an increased quantity of these humours; but, when they corrupted or changed, then no one pretended to estimate the evil which might follow. Nay, not satisfied with corrupting themselves, these humours enticed foreign contagions to combine with them, the venereal vi-

rus lurking in the pituita, whilst the measles lodged in the choler.

THE practice which naturally followed from this theory, was to expel the morbid humour; but this they could not do, until by remedies, or the process of nature, it was concocted, and prepared for evacuation:

ALTHOUGH these were the prevailing doctrines concerning the cause of diseases, in the ancient schools, yet most physicians admitted the co-operation of an intelligent principle*. To this principle, Hippocrates gave the name of nature, which he considers as of an excellent, and almost divine quality. This principle,

* "Medicina id quod molestat tollit, id a quo homo egrotat auferens, sanum facit. Natura eadem sua sponte novit." *Hip. de Dieta.*

we are informed, is heat*; by which term, however, we are not to understand him as meaning common fire, but a principle sui generis; for the ancients used this term in a very extensive sense. Thus, Aristotle† tells us, that the soul of man is heat; but cautions us from believing, that he means exactly any thing which we have ever seen in another situation.

By comparing some passages of Hippocra-

* The original theory of animal heat, was, that a calor nativus, or innate heat, existed in the left ventricle of the heart, which went out by the vessels, and supported the body.

† "There is a certain animal heat diffused through the universe, so that all things are, in a manner, full of mind; on which account, they may be quickly completed into animals, when they have received a portion of this heat. This is not fire, nor any thing like it, but a spirit which is in the femina, or elementary principles of bodies." *Aristotle de Generat. Anim. lib. iii. c. 11. et lib. ii. c. 3.*

res with each other, and with the writings of the philosophers who lived about that time, we shall find it to be most probable, that, by the operations and interference of nature, he meant the agency of the soul*; a doctrine which was more

* The left ventricle is larger than the right, and is, as it were, gnawed. "Nam insitus a natura ignis non est in dextro." "Mens enim hominis in sinistro ventriculo insita est, et reliquæ animæ imperat." *De Corde.*

"Et videtur sane mihi id quod calidum vocamus, immortale esse, et cuncta intelligere, et videre, et audire, et scire omnia tum præsentia tum futura." *De Carnibus.*

"Ignis enim omnia per omnia movere potest." *De Dina.*

Some were unwilling to admit, that Hippocrates really supposed that the soul had its seat in the breast, and imagined, that he either said so in compliance with common language, or because the great instrument of the mind (heat) resided there: But by comparing his words with the ideas of Aristotle, concerning the nature of the soul, it will appear, that he really believed the heart to be the seat of the anima, although its mental operations, or faculties, were exercised in the brain; and also, that the anima consisted of a somewhat, which he denominated heat.

expressly repeated by Stahl, and adopted by Mead *, and many of the more modern physicians.

Anaxagoras, more decidedly, said, that nature was the mind, or soul, "mentem appellat." Galen said, that nature was a warm spirit, "Natura item est spiritus calidus." Zeno, more bold, declared it to be common fire.

* "Such is the composition of our fabric, that when any thing pernicious has got footing within the body, the governing mind gives such an impulse to those instruments of motion, the animal spirits, as to raise those commotions in the blood and humours, which may relieve the whole frame from the danger in which it is involved." *On the Small Pox.*

In pestilential fevers, "the mind hurries to the assistance of the labouring frame, fights against the enemy," &c.

Med. Precept.

"Quis non videt in acutis pulsum vibrare vehementius, sanguinem fervere, turbari omnia? Hæc ipsa vero virtus nature est, quæ alienum et crudum sic potentius subigit et suis nocendi viribus exuit, vel si exuere penitus non potest, ne novas turbas moliat, tanquam indignum a vis suis calorem variis viis inter critica, ut vocant, molina expellit." *Richter's Opuscula, Tom. I. p. 313.*

THE notion of all the humours being diseased, was at last, in a great measure, overlooked, or attended to only by the bye; and the state of the blood began to be considered as almost the only immediate cause of disease. The pathology of Sydenham was founded entirely on the condition of the blood, and the operation of the *vis medicatrix naturæ*. When a contagion was introduced into the blood, then nature excited a fermentation, in order to concoct, and finally expel it. This she did, sometimes quickly, sometimes more slowly, generally by the help of a fever, terminating by looseness, or sweating. But in this, as well as in every other theory which admits the assistance of nature, we find, that the cause of the disease is most ridiculously misapplied; for they by no means prove, that the peccant matter taken into the blood, would of itself be fatal; but they most abun-

dantly allow, that the interference of nature, which excites a dangerous disease, is often mortal, and, not unfrequently, the cause of the most lasting calamities. "What is gout, (says Sydenham), but a contrivance of nature to purify the blood of old men, and to purge the deep parts of the body." Few people would thank Dame Nature for this friendly purgation.

THE idea of concoction, and assimilation, was likewise adopted by Boerrhawe, and is taught still by some modern authors. But this great physician called in the additional aid of other principles, namely, the viscosity and lentor of the blood, and the error loci of its globules. This doctrine, which will be more particularly illustrated in the theory of inflammation, had, in its principle, occurred to Asclepiades, who made disease con-

sist in a want of proportion betwixt his
 atoms and the pores through which they
 were to pass. These doctrines of the ori-
 gin and cause of disease, produced the
 most unhappy practice. Venesection, e-
 metics, purges, and sudorifics, were ra-
 pidly prescribed, one after another, to
 avert the danger, and the urine carefully
 examined, to mark the progress of the
 concoction; whilst such remedies as tend-
 ed more effectually, and directly, to check
 the disease, were proscribed and forbid,
 because they produced no sensible evacu-
 ation.

The whole of these conjectures were
 evidently founded upon ignorant and
 mistaken views of the animal economy.
 Unacquainted with the true laws of the
 living system, they reasoned upon the
 supposition of the blood being subject to
 the same changes, when circulating in

the vessels of a man, as when collected and preserved in their phials and matraffes. They knew not the true history of our functions, nor the real cause of all the varied phenomena of life. Their heads were full of nothing but spirits, and humours, and ferments; and their systems were built entirely on plethora, and inanition, and cacochymy.

WHEN, at last, they began to see more clearly the agency of the nervous system, and to abandon their belief in the co-operation of different spirits to produce the actions of life, they found it necessary to allow, that diseases have their chief seat in the nervous system; but being still unwilling to give up their favourite doctrine of morbid humours, they asserted, that these still existed, but operated through the medium of the nervous energy. Hoffman maintained the seat

of diseases to be in "the living solid;" but avowed the agency of diseased blood. Cullen, who improved this theory, acknowledged, in many instances, the derangement of the fluids: Nor is there almost any system, even in the present day, in which it is not more or less allowed.

THAT medicines may, in several instances, be absorbed, and mixed with the blood, will be allowed by all; but that they thus exert the whole of their influence, cannot be admitted; nor will it, by any means, be considered as true, that either medicines, or contagions, act by changing the nature, or altering the properties of this fluid, until it be proved, that the blood is not circulating in vessels possessed of a power of acting on it, and until it be established, that the blood is completely an extraneous substance, subject to all the laws of foreign matter, and

making no part of the living system. That in disease the blood does change, to a certain degree, is ascertained; but these changes are not the consequence of any direct action upon it, by contagions, or medicines; they are analogous to the alterations which take place in the rest of the system, and depend upon the same cause, namely, a general affection of the living principle. One of the most evident changes induced upon the blood, and one which might be supposed to favour the doctrine of chemical changes, being induced directly by contagion, is its conversion from venous into arterial, and from arterial into venous; but even these changes, are very far indeed from being proved to depend upon chemistry, independently of the living principle. It is considered as proved, that the venous blood is rendered arterial, by the oxygen of the atmosphere being combined

with certain principles of the blood, and carrying these off, and that it is again rendered venous, by the addition of these substances; but it is far indeed from being proved, that these combinations, and additions, take place independently of the action of the vessels; nor is it even ascertained, that the use of respiration is to purify the blood from these substances. Had this been all which was requisite, they could have been removed by some particular excretion, as we see, in part, exemplified in the formation of the bile. The production and extrication of these substances, are, however, very much connected with the process of respiration; for, we find, that whenever the arterial blood is converted into venous, which transition takes place suddenly, certain substances are found in it; and these again are evolved, during the instant of its being changed into arterial. I formerly mentioned my

supposition of the production of vitality being the main intention of the function of respiration. This principle seems to be yielded to the nerves, by the minute arteries; and, at the same instant, the blood becomes black and venous. There is then this connection betwixt the purification of the blood from carbone and hydrogen^e*, and the arterialization of it, or the furnishing of the vital principle, that both take place at the same time, and that the one process is, perhaps, instrumental in producing the other †.

* Some deny that hydrogen^e is found in the blood; but other experiments prove, that it does make a part of venous blood.

† In the fetus, these changes on the blood take place without the assistance of the air, by the peculiar operation of the placenta, in which the blood is both freed from its carbone and hydrogen^e, and likewise acquires vitality, and the materials of nourishment. Some suppose, that this depends upon the fetal blood coming in contact with the maternal in the placenta; but this is by no means proved.

THE blood is to be considered as a living substance, possessed of peculiar properties, and endowed with the power of preserving its specific nature, in common with other bodies. It is only whilst it remains in this living state, that it is useful to the system; for, if its nature be changed, it is no longer that fluid which is requisite for life. It cannot even be rendered all venous, which is the most natural and easy change which it can undergo, without immediate death being the consequence to the animal. How unphilosophical, how absurd, then, must it be, to talk of fermentations, assimilations, and putrefactions of the blood; and how thoroughly ignorant of the animal economy must they be, who can use such language, or have recourse to those miserable explanations of the cause of disease!

FROM the whole of these considera-

tions, we may reasonably conclude, that we are to look for the origin and seat of disease, not in the ideal habitation of humours and spirits, not in the chemical changes or fermentations of the blood, but in the nervous system.

SOME of those who attended most to this system, attributed much to spasmodic actions; some admitted peculiar and varied actions of the nervous system; whilst others referred disease entirely to the different degrees of excitement, as they called it, of the living principle.

THE first of these suppositions was very ably supported by Dr. Cullen, who believed, that, in many instances, the *vis medicatrix naturæ*, in order to get quit of some noxious power, formed a spasm on the extreme vessels, the consequence of which was, an increased action of the

heart and arteries, in order to overcome this, and cure the disease *. How far this theory explains the different circumstances attending inflammation, and, consequently, how far it is founded upon facts, and good reasoning, will afterwards come to be considered; and, therefore, to prevent repetition, I shall only observe, in this place, that the Cullenian doctrine is subject to this objection, in common with others, which admit the operation of an intelligent principle in the cure of diseases; that the whole series of dangerous symptoms, or, in other words, the disease itself, is produced, not directly by the application of hurtful agents, but by the supposed interference of the healing power of nature, *quod erat absurdum*.

MR. HUNTER has given us no regular

* First Lines, &c. Vol. I. chap. li.

system of pathology; but, by gleaning his works, we learn, that he considers, first, that every operation of the body is an action of the living principle*; second, that no two actions can take place at the same time, and in the same part, more than two different motions in a piece of matter†; third, that a disease is propagated from a part to the whole, by means of the sympathy which exists through the whole body, by the diffused principle of life. This principle “is, as “it were, diffused through the whole “solids and fluids, making a necessary “constituent part of them, and forming “with them a perfect whole, giving to “both the power of preservation, the “susceptibility of impression, and, from

* Hunter on the Blood, &c. p. 3.

† Ditto.

" their construction, giving them consequent reciprocal actions. This is the matter which principally composes the brain *."

UPON the two first propositions I shall make no remark, because I have already endeavoured to establish and illustrate them. They are, in my opinion, the most rational foundation upon which a system of physic can be reared, and are so self-evident, that they occurred to me soon after I began to study medicine, and before I had any opportunity of knowing that they were proposed by Mr. Hunter. Upon the third proposition, I have only to repeat the remark which I formerly made, that it teaches a very confined idea of life, which, according to this supposition, can only be united

* Hunter on the Blood, &c. p. 89.

with a certain structure, the existence of which, in many cases, is far from being proved.

DR. BROWN attempted to simplify medicine, and reduce every disease to one of two causes *. He began by observing, that "a certain quantity of excitability" (or living principle) is allotted to every "one at birth †."—"That this is acted upon by different powers, which are termed exciting powers; and their effect on the excitability is called excitement ‡."—"This mutual relation obtains betwixt excitability and excite-

* This doctrine had, in its principle, occurred to Themison, the founder of the Methodic sect, who maintained, that diseases depended upon either an overbracing or a relaxation of the system.

† Elements of Medicine, Par. xviii. p. 7.

‡ Par. xvi. p. 5.

"ment, that the more weakly the pow-
 "ers have acted, or the less the stimulus
 "has been, the more abundant the ex-
 "citability becomes; the more powerful
 "the stimulus, the excitability becomes
 "the more exhausted *."—"In both
 "of these circumstances, weakness takes
 "place, which, in the first case, is called
 "direct, in the second, indirect †."—"It
 "is the excitement alone, through its va-
 "rying degrees, that produces either
 "health, disease, or recovery, ‡."—"The
 "general diseases, arising from excessive
 "excitement, are called sthenic; those
 "that originate from a deficient excite-
 "ment, asthenic. Hence there are two
 "forms of diseases, and both are always
 "preceded by predisposition §."—"That

* Par. xxiv. p. 15.

† Par. xxxv. and xlv.

‡ Par. lxii. p. 50.

§ Par. lvi.

" this is the only real origin of diseases
 " and predisposition *, is proved, by the
 " same powers which produce any dis-
 " ease or predisposition, also producing
 " the whole set of diseases to which it
 " belongs; and by the same remedies
 " which cure any disease or predisposi-
 " tion, also curing all the diseases and
 " predispositions of its respective form †.
 The operation of all contagions is stimu-
lant, and " no remedies, but those that
 " cure diseases produced by the usual
 " noxious powers, remove those suppos-
 " ed to be induced by contagion ‡."—
 " Though the fluids may be corrupted,

* " Predisposition is a state intermediate betwixt perfect
 " health and disease. The powers producing it are the
 " same with those which produce disease." Par. lxxiii.
 p. 59.

† Par. lxxvii. p. 51.

‡ Par. xxi. p. 10.

“ yet this is not a cause, but an effect of
 “ weakness. Wine, bark, &c. by strength-
 “ ening the vessels, purify their con-
 “ tents *.” In the indication of cure,
 the only regard to be had to morbid
 matter, is to allow time for its passing
 out of the body; and that, whether it
stimulates or debilitates, or gives the pe-
 culiar form to the disease, thereby add-
 ing a local to a general complaint; for,
 if the general disease be properly healed,
 the eruptions, inflammation, ulcers, will
 give way to the happy effects of the ge-
 neral cure †.

To conclude, “ the whole and sole
 “ province of a physician, is not to look
 “ for morbid states and remedies, which

* Par. cxviii.

† Par. xcvi. p. 81.

" have no existence, but to consider the
 " deviation of excitement, from the
 " healthy standard, in order to remove
 " it by the proper means *."—" Such is
 " the simplicity to which medicine is
 " thus reduced, that when a physician
 " comes to the bed-side of a patient, he
 " has only three things to settle in his
 " mind; first, whether the disease be
 " general or local; secondly, whether it
 " be sthenic or asthenic; third, what is
 " its degree †."

UPON this system I would have ex-
 pected, that very little observation would
 have been necessary to show its absurd-
 ity; and I should have done no more
 than merely state it, were we not every

* Par. cxlix. p. 138.

† Par. lxxix. p. 64.

may told of the progress which it is making. One great and leading error, which every one will observe, is, that he supposes the more life or excitability that any person has, the nearer he is to death*. Here the dependence of energy for its production, upon the continuance of natural action, is overlooked. When the action is too little, energy is not produced; when the action is too great, or in a morbid degree, its production is not only injured, but more is expended than can be generated. These are the effects produced by a deficiency or increase of action, to a morbid degree. There can be no accumulation of life, or, were it to take place, as from want of food, for instance, then it follows, that any stimulus given before death, should preserve life; and the living power being very

* Par. xxiv.

abundant, the person ought easily to bear a strong stimulus, which is far from being the case,

THIS, however, is a very trifling mistake, when compared to the next error, which teaches, that all diseases consist entirely in different degrees of excitement of this life, and not in any new and peculiar operation or action which it performs. Do not all the phenomena of fevers, small-pox, syphilis, and almost every disease, controvert this doctrine in the strongest manner? Will every stimulant cure the venereal inflammation? Will wine cut short the progress of a fever? Is it debility alone that is to be regarded in the treatment of a fever, and stimulants alone that are to be administered *? I will venture to affirm,

* Par. dclxxx.

that if this practice be followed out, no man can estimate the lives which shall be lost. If debility alone produces fevers, I will demand of the Brownonian, Why, in the course of a few hours, the pulse falls from its great frequency almost to the natural standard, and that without any stimulant being exhibited, or the patient feeling, in the least degree, stronger, or being able to make one greater exertion? I shudder when I recollect the scenes which I have witnessed, and the miserable effects of the blind Brownonian practice. Wine and opium, I do most sincerely believe, are, in the hands of Brown's disciples, what fire and sword are in the battles of the cruel.

FROM the apparent simplicity of this theory, the student is led to neglect the various operations of the system, and disregard the nicer symptoms and distinc-

tions in diseases, being taught, that his sole province is to inquire into the degree of excitement, that he may bleed in one case, and give wine in another. And, to remove any scruples which may still remain in his mind, concerning the radical differences of diseases, he is assured, in the strongest manner, that in no respect are they different, except in the circumstances of strength or weakness; that there are no specific operations of the living system, no alterations even in the fluids, (which were to the humouralist what the nervous system ought to be to the true physiologist), modifying the disease; and that, therefore, he need not, on this account, think of varying his treatment; for all eruptions and conditions, thus induced, will yield to the sthenic or asthenic plan.

FROM this leading error in the system,

it is astonishing how little able many Brownonians are to distinguish betwixt two dissimilar diseases, which have some general symptoms in common. This, it may be said, ought to be placed to the account of the stupidity of the physician; but, certainly, the doctrines which this system teach, are well calculated to increase that natural stupidity, by giving little incentive to investigation.

OF late, this theory has been modified, by the introduction of chemical principles, many diseases being attributed to an increase, or deficiency, of oxygen, as well as a deviation from the due state of excitement. Whether oxygen be, or be not present, in greater and less quantities, at different times, is a point which I shall not inquire into; but I think it is pretty evident, that if, in any disease, there be too much, or too little, of any chemical

principle present, or employed in the whole system, or a part of it, the mere addition or subtraction of part of that principle will not inevitably cure the disease, because we do not thus alter the action which constitutes the disease; and this redundancy, or deficiency, is a symptom, and not a cause. We never can prevent the introduction of what may be called the chemical elements into the body by any means whatever. They are all essential to our existence, and the modification which they receive will continue as long as the action exists which regulates or produces it, whatever chemical or mechanical contrivances we may fall upon to prevent it. If phthisis depended upon the presence of too much oxygen in the blood, which is not proved, we could not cure it by breathing an impure air, because the oxygen which the atmosphere did contain would be more

completely consumed; and if we gave less than the quantity necessary, respiration would cease to be properly performed, just as it would in health be injured by a proportionate diminution. It is likewise a very mistaken notion, that because hydrocarbonate, and other airs, mixed with that which we breathe, give relief sometimes, therefore a diminished quantity of oxygen is useful. They forget that these airs are very powerful medicines, and act independently of their mechanically lessening the quantity of oxygen, by occupying its place. The proper argument would be, to prove, that the poor, in their low, ill aired habitations, live longer in consumption than the rich, which few will believe. It is likewise conjectured, that, by adding the chemical principle in superabundance, we induce the disease or condition, which is supposed to depend upon the presence of

this ; as, for instance, it is supposed that too much oxygen will produce phthisis ; if so, the purest air ought to be most unhealthy, and those who live in the country, and on mountains, ought to be most subject to consumption. So sanguine is one gentleman in his belief of this doctrine, that he hopes, chemically, to suspend the laws of nature, and make the trees distil butter and cream. This would be a valuable discovery for the Hindoos ; for, by a similar process, they might procure beef and mutton, without taking existence from an animated being. I know only one story which can match this, and indeed the whole theory, and that is, the old tale of a town, where roasted pigs run through the streets with knives and forks stuck in their posteriors, crying, Come eat us ! Come eat us !

THE last theory which I shall take no-

rice of, is that of the very ingenious Dr. Darwin; which, in one respect, is similar to the Brownian doctrines, but differs in the particular steps, leading to the general principles.

To examine this theory fully, would, on account of its complexity, require more time than is compatible with my present purpose. I can, therefore, only give here the outlines, and most fundamental parts of the doctrine.

“THE whole of nature* (according to Dr. Darwin) may be supposed to consist of two essences, or substances, one of which may be termed spirit, and the other matter. The former of these possesses the power to commence, or produce motion, and the latter to re-

* Zoonomia, Vol. I. p. 5.

"ceive and communicate it. So that
 "motion, considered as a cause, immedi-
 "ately precedes every effect; and, confi-
 "dered as an effect, it immediately suc-
 "ceeds every cause."—"The motion of
 "matter may be divided into two kinds,
 "primary and secondary. The secon-
 "dary motions, are those which are
 "given to, or received from other mat-
 "ter in motion."—"The primary mo-
 "tions of matter may be divided into
 "three classes; those belonging to gra-
 "vitation, to chemistry, and to life; and
 "each class has its peculiar laws."—
 "This last class of motion is the subject
 "of the following pages." Motion, which
 is defined "to be a variation of figure *,"
 is divided, in the animal body, into two
 classes:

* Zoonomia, Vol. I. p. 15.

FIRST, Sensorial motions, or those peculiar to the sensorium, which constitute the sensation of pleasure and pain, and which constitute volition, and cause the fibrous contractions, in consequence of irritation, or association. These motions are not fluctuations of the spirit of animation, nor vibrations, nor equilibrations, but changes, or motions of it, peculiar to life *. They are the faculties, or motions of the sensorium, to be afterwards mentioned.

SECOND, Fibrous motions, which include the motions of the muscles, and organs of sense †, which are contractile, and which, by their various configurations, give us ideas.

* Zoonomia, Vol. I. p. 33.

† Ditto.

THE spirit of animation is the immediate cause of the contraction of animal fibres. It resides in the brain and nerves, and is liable to general and partial diminution, or accumulation. It is also called the sensorial power*.

THE stimulus of external bodies is the remote cause of this contraction.

A CERTAIN quantity of stimulus produces irritation, which is an exertion of the spirit of animation, exciting the fibres into contraction.

A CERTAIN quantity of contraction of animal fibres, if it be perceived at all, produces pleasure; a greater, or less quantity of contraction, if it be perceived at

* Zoonomia, Vol. I. p. 30.

all, produces pain. These constitute sensation.

A CERTAIN quantity of sensation produces desire, or aversion. These constitute volition.

ALL animal motions, which have occurred at the same time, or in immediate succession, become so connected, that, when one of them is reproduced, the other has a tendency to accompany or succeed it. When fibrous contractions succeed or accompany other fibrous contractions, the connection is termed association: When fibrous contraction succeeds sensorial motions, the connection is termed causation: When fibrous and sensorial motions reciprocally introduce each other, it is termed catenation of animal motion. All these connections are said

to be produced by habit, that is, by frequent repetition *.

THE spirit of animation acts in four different ways, or "possesses four different faculties †;" and the contraction of all the fibrous parts of the body depends upon the exertion of these powers. The property, or capability, of causing fibrous contractions, in consequence of the irritation of external bodies, is called irritability, and the effect irritation; which is defined to be an exertion, or change of some extreme part of the sensorium, residing in the muscles or organs of sense, in consequence of the appulses of external bodies.

THE faculty of causing fibrous contractions, in consequence of the sensations of pleasure and pain, is termed sensibility,

* Zoonomia, Vol. I. p. 31.

† P. 32.

and the effect sensation; which is an exertion, or change of the central parts of the sensorium, or of the whole of it, beginning at some of those extreme parts of it which reside in the muscles or organs of sense.

THE power of causing fibrous contractions, in consequence of volition, is called voluntariness, and its effect volition; which is an exertion, or change of the central parts of the sensorium, or of the whole of it, terminating in some of these extreme parts of it, which reside in the muscles or organs of sense.

THE capability of causing fibrous contractions, in consequence of the association of fibrous contractions with other fibrous contractions, is termed associability, and the effect association; which is an exertion, or change of some extreme

part of the sensorium, residing in the muscles or organs of sense, in consequence of some antecedent, or attendant fibrous contraction.

As these faculties, at the time of their exertion, may be termed motions (for we cannot pass from a state of insensibility or inaction to a state of sensibility or exertion, without some change in the sensorium, and every change includes motion), they may be called sensorial motions.

THE fibrous motions of the animal, then, are of four different kinds, irritative, sensitive, voluntary, and associate.

IN every contraction of a fibre, there is an expenditure of the sensorial power, or spirit of animation; and, when the exertion of this sensorial power has been

for some time increased, and the muscles, or organs of sense, have, in consequence, acted with greater energy, there is an exhaustion of the quantity of power: On the contrary, when there has been less exertion, it becomes accumulated in the inactive part*.

STRENGTH is the consequence of the presence of a great quantity of stimulus and sensorial power; for the quantity of motion produced in any particular part of the animal system, will be as the quantity of stimulus, and the quantity of sensorial power, residing in contracting fibres.

If the quantity of sensorial power remain the same, but the quantity of stimulus be lessened, then *debility from defect of stimulus*, or direct debility of Dr.

* Zoonomia, Vol. I, p. 72.

Brown, is produced; in which case the contractions are feebler, and often retrograde.

If the quantity of stimulus remain the same, but the quantity of sensorial power be lessened, then *debility from defect of sensorial power*, is produced, or indirect debility*.

DISEASE is the consequence of any deviation of these motions from the healthy state; and, therefore, are divided into diseases of irritation, sensation, volition, and association†; for an account of which, as well as of the minuter parts and illustrations of the theory, I must refer to the work itself.

IN examining the truth of this theory,

* Zoonomia, Vol. I. p. 75.

† P. 361. et seq.

it is proper, first, to consider, how far the doctrine of simple motions will explain the phenomena of life; and, second, how far their derangement will account for the different diseases. It would be endless to follow the application of this theory through the whole animal economy. I shall deem it sufficient to attend only to one or two functions, particularly digestion and secretion.

THE whole system, says Dr. Darwin, consists of extremities of nerves; and all the filaments either do possess, or once possessed, the power of contraction*. By the motion of these fibres, are all the operations of the living system, and all its functions, immediately performed. Now, these motions can only consist either in contraction or dilatation,

* Zoonomia, Vol. I. p. 463.

in various directions. This, I apprehend, must be admitted; and no other kind of motion is proposed by Dr. Darwin, except sensorial motions, which give pleasure and pain. The operation of sensation, or the sensorial motions, is indeed very fully admitted in this theory, and supposed to regulate many of the functions*; but still these must, in the end,

* "If the food which we swallow is not attended with
 "an agreeable sensation, it digests less perfectly; and, if
 "a very disagreeable sensation accompanies it, such as a
 "nauseous idea, or very disgusting taste, the digestion be-
 "comes impeded, or retrograde motions, of the stomach
 "and oesophagus, succeed, and the food is ejected."
 Zoonomia, Vol. II. p. 390.—"Every kind of gland must
 "possess a peculiar kind of irritability, and, probably,
 "sensibility, at the early state of its existence, and must
 "be furnished with a nerve of sense, or of motion, to per-
 "ceive, and to select, and to combine, the particles which
 "compose the fluid it secretes." P. 516.—"It would
 "seem, that all the glands in the body have their secreted
 "fluids affected, in quantity and quality, by the pleasur-
 "able or painful sensations, which produce or accompany

operate upon the fibrous contraction, which I can conceive only to admit of two states, namely, relaxation and contraction. Now, these never can explain the varied phenomena of life, and all its intricate and peculiar actions; neither can it possibly account for the diseases to which we are subject, even although we admit of all the complications of motion which Dr. Darwin supposes to exist.

If I have succeeded in establishing the doctrine of varied and constant actions, in the living system, then Dr. Darwin's theory, of the effects of simple motions, is necessarily unfounded; and if the ef-

"those secretions; and that the pleasurable sensations, arising from these secretions, may constitute the unnam-
ed pleasure of existence, which is contrary to what is meant by tedium vitæ, or ennui." P. 518.

fects of actions upon the body, depends not altogether upon their quantity or degree, but also upon their species, or similarity or dissimilarity to the natural action, then the supposition made by Dr. Darwin and Dr. Brown, that the expenture of power or weakness, is proportioned exactly to the quantity of exertion, motion, or excitement, is unfounded; and if the doctrine, of the production of energy being dependent upon the due presence of action, be admitted, the supposition of the accumulation of excitability, or spirit of animation, must likewise be unsupported.

BEFORE quitting this subject, I shall, for the satisfaction of the reader, take notice of the explanation which is given of fever*.

* Zoonomia, Vol. I. p. 380. et seq.

WHEN, by the application of cold, inanition, fear, &c. a torpor, or quiescence, of any considerable part of the circle of irritative motions, is induced, the whole class of them is more or less disturbed, by their irritative associations; or, in other words, if any such debilitating cause be applied to a part, the rest quickly sympathises, and becomes weakened. From the quiescence of the particular organs concerned in producing the various functions, we have diminution of these functions, sickness, vomiting, paleness, coldness, weak and small pulse, &c.

BUT, "as soon as this general quiescence ceases, either by a diminution of its cause, or by the accumulation of sensorial power, which is the natural consequence of previous quiescence, the hot fit commences." Every gland

is now stimulated into stronger action than is natural; there is a superabundance of all the secretions, and, in consequence of this, an increase of heat; the skin becomes red, and the perspiration great; but, as the absorption is still great, the sweat is not perceived, until, in the decline of the hot fit, the mouths of the absorbents of the skin are exposed to the cooler air, or bed-clothes, by which they lose their increased activity, and cease to absorb more than is natural; but the secreting vessels act for some time longer, being kept warm by the circulating blood; and, therefore, we have a sweating stage.

WHEN the contractile sides of the heart and arteries perform a greater number of pulsations, in a given time, and move through a greater area at each pulsation, whether these motions be produced by

the acrimony or quantity of the blood, or by association with other irritative motions, or increased sensorial power, or by any stimulus, we have synocha, or irritative fever, with strong pulse*. When, again, the contractile sides of the heart and arteries perform a greater number of pulsations, in a given time, but move through a less area at each pulsation, from defect of stimulus, or of sensorial power, we have typhus mitior, (or nervous fever), or irritative fever, with weak pulse†. Besides these febrile motions, induced by irritation, it frequently happens, that pain is excited by the violence of the fibrous contractions, and other new motions are superadded, in consequence of sensation. This, which occa-

* Zoonomia, Vol. I. p. 361.

† P. 362.

sions inflammation, gives a different form to the fever, which is called sensitive *, and, like the irritative fever, will naturally be of two kinds, having the strong and weak pulse; the first is called inflammatory fever, the second, typhus gravior. This is farther explained, by observing, that, when the motions of any part of the system, in consequence of previous torpor, are performed with more energy than in the irritative fever, (or than is compatible with the existence of simple irritative fever), a disagreeable sensation is produced, and new actions, of some part of the system, commence, in consequence of this sensation, conjointly with the irritation; which motions constitute inflammation; and, according as this has taken place, in one or other of the species of irritative fever, so shall we

* Zoonomia, Vol. I. p. 391.

have either inflammatory or putrid fever *.

UPON this subject, I shall only remark, that the general account of the production of the symptoms of fever, is not satisfactory, and that the causes assigned will not produce the effect, as will, I presume, sufficiently appear, from what has been already said in this dissertation. Cold, applied to the system, may sometimes produce fever; but, upon this supposition, it ought uniformly to do so, which is not the case; and farther, every debilitating cause, as venesection, poor diet, want of food, &c. ought always to be followed by paroxysms of fever, in consequence of the quiescence which they induce. There is, likewise, no proof, that sensation affects

* Zoonomia, Vol. I. p. 412.

the nature of a fever, and produces local inflammation; but there is very abundant evidence, that peculiar agents, acting on the living system, may induce fever, and modify the action, to an almost endless degree, producing the whole tribe of febrile diseases.

Summary of the Laws of Action.

HAVING made these observations upon the different systems of pathology, and having, in the course of this dissertation, endeavoured to establish the necessity of attending to the actions of the living system, and of ascribing to them the phenomena of health and disease, instead of indulging in speculations concerning the fluids, or their changes, or about simple excitement, or motions of the system, I shall now conclude this

part of my subject, with a short summary and illustration of the doctrine. For which purpose, I observe,

FIRST, That the nervous energy, unacted on, can exhibit no phenomena, nor perform any operations.

SECOND, Arterial blood seems to be the natural and indispensable stimulus to this nervous system, or agent, enabling the energy to perform its operations. It is likewise the source of renewal to this energy.

THIRD, In a state of health, there is a particular action present in the system, upon which that state depends. This may, therefore, be called the natural action, and consists, collectively, of all the operations or phenomena necessary for the existence of the animal.

FOURTH, This action is an operation of the nervous energy, which is, therefore, employed and expended in its performance ; on which account, there must be a regular renewal of power ; and this renewal is dependent upon the proper action of the nerves *.

FIFTH, All external agents, or foreign bodies, capable of operating on the body, must induce an action, more or less different from the natural one ; or, in other words, will change the action of the sy-

* In some diseases, we find, that the nerves do not take from the blood as much life as it is capable of yielding. In this case, the blood in the veins is redder than usual, and, when drawn, coagulates, almost totally, into a mass, containing, like the coagulum of arterial blood, the greatest quantity of the serum, blended with the other principles. In many diseases, proceeding from derangement of the stomach and bowels, and in approaching syncope, this fact may be observed.

stem to a greater or less degree. As it is certain, that no two actions can be separately performed by the same part at once, more than the tongue can articulate two languages at the same moment *, it follows, that the new action, thus induced by foreign agents, must be a complication of the new action with the natural one; or, to speak more properly, the natural action becomes modified by the new stimulus; and the more that this action is changed, or becomes diseased, the more must the part suffer. From observation fourth, it will appear, that the production of energy must be thus injured; and it will be at once evident,

* Although no two actions can exist separately in the same place, and at the same time, yet they may sometimes become blended, producing an action different from either. Some actions, however, cannot be thus blended, but the one will either displace the other, or will not take place at all.

that if health and strength consists in the due existence and performance of the natural action, if this action be changed, weakness and disease must be the consequence; and, likewise, that these diseases are most dangerous in which the action is greatly changed; whereas, in these in which it is less altered, the danger is less, and they may subsist longer without producing death.

SIXTH, It is necessary, that every new agent, or stimulus, should have a certain degree of strength; or, in other words, possess a certain quantity of the peculiar power by which it operates, in order to act upon the living system; because the natural action, if I may use the expression, keeps its ground, with a certain degree of tenacity, and will only yield to a certain force. For example, a grain of ipecacuan, a drachm of glauber salt, a

drop of laudanum, or contagious matter, much diluted, will produce no effect upon a man. Were this not the case, we never should enjoy health; because the small quantity of contagious matter, which we may suppose to be often contained in the air, should uniformly affect us. The less energy that a person has, the weaker is the natural action; and, the weaker that the natural action is, the easier is it changed, or destroyed. Hence, the child is more easily injured than the adult; and he who is reduced by fatigue, abstinence, or previous disease, than the healthy and robust man. This law likewise obtains, with regard to the actions of sense, as every one knows who has attended to the phenomena of seeing, hearing, tasting, &c.

SEVENTH, Certain agents, which may have strength enough (by which I mean capability) to change the natural action,

will not be sufficient to affect it, if it has already been modified by the previous application of a different agent. It is on this account that contagions often fail, at particular times, to produce their effect: Because the presence of some other agent has previously modified the action, more or less; and, until the effects of this be gone off, no new disease takes place, unless the new stimulus be very dissimilar indeed to that which induced it. We have an instance of the one case, in small-pox not displacing measles; of the second, in mercury destroying the venereal action.

EIGHTH, The agent in general operates most on the part to which it is immediately applied, if that part be susceptible of its operation, and in a less degree upon neighbouring parts. The degree, however, to which these agents may extend their action,

is very various. Some, for instance, when taken into the stomach, extend their action over the whole system, whilst others act only upon the stomach itself, and produce no effect on the rest of the body, except such as take place in consequence of the sympathy of equilibrium. When heat is applied to a part, it inflames that part, but acts likewise, in a less degree, on those which are near it; so that if one spot, to which most heat was applied, mortifies, or forms an eschar, those near it shall only exhibit a moderate degree of inflammation. Cantharides likewise extend their action beyond the spot to which they are applied, but in a much less degree than heat. Contagions, however, producing specific inflammation, are more confined in their operation than simple inflaming causes. Specific inflammation generally terminates more abruptly; that is to say, it does not diffuse

itself so far as simple inflammation; but sometimes it is surrounded by simple inflammation. Thus the variolous inflammation is surrounded by a simple erysipelatous inflammation.

NINTH, The impressing cause, or stimulus, must not only be of a certain strength, but it must also be applied for a certain length of time before it can produce its effect. That some time is necessary for the formation of an action is evident; because, setting all other reasons aside, we observe a certain interval betwixt the first derangement of the natural action and the appearance of the new action, in its full and proper state. This period of formation is always marked by symptoms of weakness, such as lassitude and chilliness; and the effects of impaired functions, such as anorexia, thirst, and head-ache, even although the action, when

fully formed, should be such as to require bleeding, and what are called sedatives, as we see illustrated by the history of inflammation. These symptoms do not precede those actions alone which are called diseased; for we find similar effects produced during the formation of those actions which are afterwards to become permanent and natural. Thus the child during dentition, the young animal during the shooting forth of his horns, the peacock when he gets his crest, and the turkey when the fleshy excrescences on the head are formed, have all a diminution and affection of the natural action, producing disorder of the system, and sometimes even death itself. The time which is required for the formation of these actions is various; nor can the exact duration, in every instance, be easily ascertained. It may, however, be observ-

ed, in general, that the more dissimilar the new action is to the old or natural one, and, consequently, the more dangerous that it is, the sooner is it formed *; but as many causes (particularly the previous existence of other actions, or modifications of the natural action, although so slight as not to be much attended to) may tend to interrupt and postpone the establishment of the action, the period of formation in the same action may be different at different times. And, farther, as the constitution or natural action of no two people are exactly alike, the time of formation will vary in different people; and, in some, particular actions may never, or very seldom take place, although

* The fevers, vulgarly called putrid, that is, very bad fevers, come on with a shorter cold fit than those which are milder. The position is likewise illustrated by many other diseases.

they be fully exposed to the exciting cause*.

BUT besides this time which elapses during the formation of an action before it fully appears, there is likewise an interval betwixt the application of the cause and the commencement of the formation; but this is much less in some diseases than in others. It is natural, however, to suppose, that this interval bears some proportion to the quickness of the formation. The contagion of very bad typhus fevers, for instance, operates much sooner than that of the common nervous fever, as it is called.

A KNOWLEDGE of the different times required, by certain agents, to produce

* Some people are much less subject to fevers, to typhus, &c. than others; and some never take the small-pox.

these effects, is of no small importance, because we may thus be able to escape their action, in many cases. By washing off some contagions shortly after their application, we prevent the disease, as we see illustrated by syphilis. In cases where poisons are taken into the stomach, we can prescribe an emetic, which operates more quickly, and thus removes them; and, for this purpose, we employ white vitriol rather than emetic tartar, because the one acts more speedily than the other.

TENTH, The same stimulus will always produce actions radically the same; but varying the degree of stimulus will often so affect the action, as to make it apparently different. Thus heat, in a small degree, makes the natural action be carried on more perfectly, and gives pleasure; but, in a greater degree, it in-

creases the action so much, as to change its appearance, or visible effects and symptoms, producing inflammation, which, from analysis, we learn to be an increase of the natural action.

ELEVENTH, The action remains for some time after the agent is withdrawn. If this were not the case, we should always be able to cure a disease, by removing the exciting cause, which no one expects to be able to do. Removing a blistering plaster, for instance, will not immediately remove the inflammation which it has produced. There is, however, no certain rule for the duration of these actions; because one continues much longer than another; and some seem even to have no tendency to decrease or disappear after any duration, however long*.

* It is impossible, in the present state of our knowledge, to ascertain the immediate cause of this. We cannot, for

TWELFTH, All actions affect one part of the body more than the rest. Sometimes there is only one organ affected, producing a disease entirely local; at other times, the whole system suffers; but, in this case, there is always one part in which the action chiefly exists.

ALL morbid actions, which are extended over the system, affect the circulation, and produce frequency of pulse; and, when fully formed, heat of the skin. These, when concentrated in any part, or when they affect any organ to a great degree, produce a species of inflamma-

instance, say why the variolous inflammation subsides spontaneously in a few days, whilst the venereal action remains unabated through life; neither can we tell why the action induced by opium subsides in a few hours, whilst that of typhus continues for days; why some actions disappear and return alternately, for a length of time, and others remain constantly the same.

tion; and it is easy, from the connection of the inflammatory action with the state of the vessels, to see how this should take place. If the action exists to less degree than this in the part, then it does not produce inflammation, but only pain, and a state bordering on inflammation.

THIRTEENTH, When specific inflammation is induced in any part, the susceptibility of the neighbouring parts, for assuming this, is lessened; and they seldom do assume it, unless some stimulant be applied to them. Thus, a certain number of pustules are produced in small-pox, by which the rest of the surface is less subject to the variolous inflammation. If, however, other stimulants be applied, such as heat, then, notwithstanding the diminished susceptibility,

the inflammation is excited, and a great eruption is produced.

FOURTEENTH, Those agents which induce actions nearly similar to the natural one, or which change its nature little, at least comparatively speaking, may be called *agentes similes*: These, which have also been named stimulants, uniformly produce weakness, after their operation is over, unless it subside very slowly, and thus allow the natural action gradually to regain its perfection before their artificial action disappears, and, consequently, before the system can be reduced to an inactive condition, as we see in the effects of great and sudden muscular exertions, which weaken more than a long continued, but gentler action, though this, in the sum, be greater than the other.

As these actions resemble, in some degree, the natural action, they also, in some degree, supply its place; and we often do not so readily, during their continuance, perceive the weakness which they induce; but, at other times, we can readily detect its existence, at least in particular functions. Thus, for instance, the presence of inflammation uniformly impairs the function of the inflamed part, as we see in the case of muscular motion, which is diminished in rheumatism; for, independent of the pain, we could not make the same exertion as formerly; and, in synocha, we cannot walk, nor eat, nor do what we used to do. If, however, the action be still more nearly resembling the natural action; or, if the nature of the healthy action be still less changed, then we do not perceive the weakness as long as it continues, as we see in the case

of the vinous action; on the contrary, the person can make a greater exertion during it, because it differs very little from the natural action *.

When the action of any part is much increased, its power is expended; and, therefore, in order to prevent farther weakness, after the operation of the stimulant is over, we find, that the action of the system is diminished in proportion to the diminished power, and both are

* According to the Brownian doctrine, stimulant actions should not produce weakness until their operation be over. But experience proves, that the reverse is the case; and I have endeavoured to show why it does not appear in every period of an action, and in which actions we are to expect it. We do not observe it in the vinous action, if it exist only in a slight degree; but if it be greater, it becomes evident. We observe it uniformly in inflammatory diseases, and, indeed, during the continuance of every stimulant action, if it be induced to a considerable degree.

only slowly increased or renewed. This fact is overlooked by the Brownianians, who give stimulants in this case, as they say, to increase the excitement. But this practice is evidently improper, in most cases; and, where it is admissible, the quantity of stimulus must be very small, and must be of such a kind as tends to excite the natural action of the part; as, for instance, soups for the stomach, &c.

THE more quickly that the stimulant action is induced, and the greater its degree, the more quickly does the weakness appear, and the greater is it. This evidently must be the case; because action requires power or energy*; and the more quickly that it is raised, the less

* It is easy, from this, to see how weakened parts should bear disease worse than the strong.

able is the nerve to supply this energy*. When a part is scalded with water, there is a very great action instantaneously induced; and, therefore, there is a weakness of the part very quickly induced; and the inflammation requires the application of gentle stimulants for its cure, as will be afterwards mentioned. If the degree of heat has been still greater, then immediate death, or mortification of the part, takes place, and an eschar is formed.

FROM these remarks, it is evident, then, that increased action, in consequence of the application of stimulants producing diseases, as well as an increased exercise of particular functions, will produce

* One cause of this, amongst many others, is, that the more abrupt the transition is, from one state to another, the more is the function injured.

weakness, which will be sensibly perceived, unless the stimulant action very nearly resembles the natural one, and subsides very gradually. The vinous action, unless it has been moderate, and, consequently, lessens gradually, produces weakness; muscular exertion fatigues; too much food taken into the stomach weakens it, and vomiting, or temporary dyspepsia, take place; heat overpowers the system, and causes fainting,

FIFTEENTH, Those agents which induce actions very dissimilar to the natural action, may be called dissimiles, and produce great weakness very quickly; whereas, in many instances of stimulant actions, when they do not arise to a great degree, the sensible weakness is not perceived for a considerable time, and until the stimulant action has subsided.

THE agentes dissimiles, or what have been improperly called sedatives, may, like the agentes similes, or stimulants, induce very violent actions, and will often require the use of such remedies as tend to abate action in general; such as, cold and blood-letting. These actions are always attended with an inflammatory affection, when they exist, in a great degree, in any organ. That typhus is always attended with an inflammatory affection of the head, and sometimes of the lungs, or abdominal viscera, must be acknowledged by every one, who is conversant in dissection: That the plague and yellow fever are attended with inflammation, is equally certain: That lead induces inflammation, is so well known, that bleeding is frequently used, with success, in the cholic which it produces: Laurel water produces an inflammatory or hemorrhagic action of the brain, marked frequently by

delirium, red eyes, and turgidity of the vessels. It must, therefore, appear, that the medicines, called sedatives, have no title to that appellation, which belongs only to such agents as tend to abate action in general; and, therefore, can only be properly applied to venesection, and cold, and abstinence, which, under certain circumstances, abate action, not indeed by any positive power, or peculiar quality, but negatively, by removing causes, which keep up action.

NOTWITHSTANDING the utility of bleeding, in the beginning of many actions belonging to this class, it yet must be remembered, that the practice is hurtful, if employed too late, and after any very considerable weakness is induced, by the continuance of the dissimilar action: Opposite remedies will then be of use.

THE actions belonging to this class are by much the most dangerous, as will appear from one or two examples.

WHEN a person is bit by a serpent, we invariably find very great weakness produced, with more or less rapidity. The countenance becomes pale, a tremor seizes the whole body, the breathing becomes hurried and oppressed, and the pulse weak and irregular; convulsions close the scene. These are the general effects of the bite of venomous animals; but we find different modifications taking place, according to the specific difference of the poison. The bite of some serpents is fatal in less than an hour, whilst that of others does not kill for a much longer time. Some produce violent convulsions, others a stupor; some cause excruciating pain, whilst others kill with an easy insensibility.

THE poison generated by rabid animals, is likewise a very powerful agent diffimilis, producing great languor and dejection, and weakness of all the functions, attended with spasmodic affections of the muscles, and particularly of those of the throat, which become convulsed, from very slight causes.

THE dissimilar agent, however, which we most frequently meet with, is the contagion of typhus fever, concerning the nature and operation of which there have been many disputes. Some have considered the putrefaction of animal and vegetable matters, as the cause producing contagion; others have referred it to an unknown state of the air; others, to certain alterations in the atmosphere, which might be ascertained and imitated by chemical processes; whilst some have denied altogether the

existence of typhus contagion. There have been still more disputes about the nature of the disease, which this contagion induced. Some called it the effect of fermentation; others, of spasm; others, of pure weakness; but the wisest part of physicians allow it to be a peculiar action, which they cannot imitate or produce, by any of those general causes.

As all these agents produce great weakness, it might be supposed, that the cure ought to consist entirely in prescribing, from the very first, such medicines as would tend to produce an action as nearly similar to the natural one as possible; such as wine, or other fermented liquors. But it is to be remembered, that, in the first place, those actions will not, in the beginning, yield to the natural one: They have already destroyed

it; and, therefore, it is not to be expected, that such agents, as tend only to excite an action somewhat similar to the natural one, should be capable of displacing these.

THERE is, however, a still more serious objection to this practice: The proposal is made, without attending to the circumstance of, what are called, sedative actions, being, in their commencement, sometimes so violent *, as to require the application of such causes as tend, in general, to abate all actions indiscriminately; such as bleeding, and the use of cold, to a moderate degree. It is like-

* There is, in the beginning of these actions, a state somewhat approaching to the condition in inflammation; and this state, of violent or increased action, continues longer or shorter, in different sedative actions. In some, it lasts only a few hours, and these are the most dangerous.

wife to be observed, that as wine cannot displace the typhus action at first, it will, by its operation, tend to increase it; and as both the contagion and the wine act more upon the head than on other parts, in proportion to their size, it will readily be seen, why the early use of wine, in fevers, so frequently produces phrenitis; for it has been already mentioned, that whenever any action was much increased, or concentrated in a particular part, it induced a species of inflammation. Wine, however, is useful, after the first stage of the disease is over, and the more immediate violence of the action has subsided, and the weakness is making progress against us. In this case, it is as useful, as it formerly was hurtful.

SIXTEENTH, Removing the sensible effects of any particular action, has a tendency to destroy the action itself,

Thus, such applications as abate the pain of the head, in typhus fever, tend to abate the fever; such as abate the heat in inflammation or fever, abate these diseases. This is called practising according to symptoms, and is a method, at all times, to be followed, even in the cure of those actions or diseases, for which we possess specific remedies, as the operation of those remedies will be greatly assisted by it.

SEVENTEENTH, Diseases are often cured also, by removing the particular state of the system, which gives to them their peculiar inveteracy or danger*. Thus, inflammation of weakened parts is removed, by strengthening the part; that is to say,

* Disease is often so connected with the state of the system in which it occurs, that removing that state of the system, shall remove the disease.

increasing its energy; which we do, by such remedies as act on the whole system, at the same time that we apply such agents to the part itself, as shall tend to change the action. It may be thought, that increasing the action of the system, in this species of inflammation, should be prejudicial, and should increase the inflammatory action; because this was perhaps originally produced by the communication of action from the neighbouring parts: But the remedies which we employ, tend not to induce an inflammatory action in those parts, but one more nearly resembling the natural action, and thus augment the energy, and diminish the inflammation. If, however, the inflammation has happened from a morbid increase of action, in a part already strong, then such remedies as tend to increase this shall do harm.

EIGHTEENTH, Actions which are suddenly induced, in healthy parts, are more dangerous than those which are excited more gradually; or, in other words, the more speedy the transition is, from health to disease, the more does the animal suffer. It is, for instance, observed, that people bear amputation better, if it be performed on account of some disease of long standing, than if we operate on account of some sudden accident; one cause of which is, that the constitution had formerly been accustomed to a diseased state, or inflammatory action; and, therefore, suffers less by the one which our operation induces.

NINETEENTH, The more the system, at the time of the application of any new agent, approaches to the general condition which that agent tends to induce, the more dangerous will the ac-

tion of the agent be, and the more readily will it operate. Thus, typhus fever tends to produce great weakness, and, therefore, will be more dangerous when it attacks those who have been formerly much reduced than those who have not. Those, again, who are very vigorous, may be said, as Mr. Hunter observes, to have their action as high as it can be without disease being induced; very trifling causes may, therefore, operate on them. Inflammation will be very high in them; and wounds, or accidents, extremely dangerous. They will even be more easily acted on by the agentes dissimiles, or sedatives, as they have been called, than those whose action is less, and nearer the proper medium, because they are more easily rendered diseased, and the inflammatory state, which these agents tend to excite will be more violent in them.

TWENTIETH, Contiguous parts sympathise with each other to a certain degree. Hence, if the action of any part be increased, the increase spreads in a less degree to the neighbouring parts, unless these parts exhibit the sympathy of equilibrium; such as the skin and liver, for instance. Hence also, if a part be weakened by cold, the action of the neighbouring parts spreads to it after the cold is withdrawn, and communicates to it a greater degree of action than its weakened state can bear; the consequence of which is inflammation, which ends frequently in gangrene. Upon the same principle, a part draws support from the contiguous parts, and bears disease much longer, on this account, than it otherwise would do. Hence, when causes act locally on a part, in such a way as to kill it, the neighbouring parts are weakened;

or, if it be a large part which is affected, the whole system is injured.

TWENTY-FIRST, When an increased action is induced in one part, it has a tendency either to diminish action in some other part, or to increase it for a time in that part, according to circumstances, which have been already explained in treating of the sympathy of association, and the sympathy of equilibrium. Contiguous parts, of a similar structure, most frequently exhibit the sympathy of association, and the action spreads more rapidly in them; contiguous parts, of dissimilar structure, exhibit, in the same circumstances, most frequently, the sympathy of equilibrium. It is evident, therefore, why all local actions extend themselves farthest, and most quickly, in those parts which are similar to the spot in which they commenced. Hence, as Mr. Hun-

ter has observed, when one portion of a gland becomes inflamed, the rest also becomes quickly inflamed; but the surrounding cellular substance, or skin, is much longer of becoming affected. Hence, also, we may sometimes check the progress of some cutaneous actions, by applying caustic round the diseased spot, so as to inclose it as with a ring; for the morbid action does not extend itself deeper than the skin, and it does not overleap the destroyed or altered substance produced by the caustic; it is therefore checked.

TWENTY-SECOND, Contagious matter, generated by animals, has a greater tendency to affect animals of the same species which produced it, than others; and the same parts in another individual which have produced or secreted it in one, rather than parts of a different nature. Thus, the contagious matter pro-

duced by the glands of the urethra in gonorrhoea, has a greater tendency to affect other secreting parts, than parts which do not secrete.

TWENTY-THIRD, Whenever an accustomed stimulus is withdrawn from a part, or the whole, the action becomes imperfect and irregular, because an agent which was wont to contribute to its production is absent. This produces pain; for all new and irregular actions excite disagreeable sensations.

TWENTY-FOURTH, The mind has the capability of perceiving and taking cognizance of the actions of the body; but if these actions be constantly repeated, we at last do not perceive them, or receive any sensation. Thus, we have no sensation from the performance of all the healthy functions, or parts of the natural

action; or from the motion of the heart and arteries. But if the action be either imperfect, or in any respect new, then it produces a sensation, which, if violent, we call pain *. If the heart contracts irregularly, or in a different manner from what it formerly did, then we feel it, and call it palpitation. All new general actions are attended with an indescribable uneasiness. When an ulcer is painful, we may be certain that the healing action is not going on; and, according to observation sixteenth, we may often cure it by such remedies as tend to abate the pain.

* We are not always to judge of the danger of an action by the pain which it produces, because some slight imperfections and irregularities in the action of a part will produce a much more acute sensation than some very dangerous actions. It is an old observation, that pain without inflammation may be borne long without very great injury to the system.

TWENTY-FIFTH, Some actions are continued by habit alone. Any action which has continued long becomes in a manner natural, that is, excited and supported by the natural agents which were operating when it was first induced, and during the continuance which the action necessarily had on account of the strong action of the original exciting cause. Many actions are thus kept up longer than they otherwise would be, and may then be interrupted by causes which, formerly, would not have operated to produce this effect. Other actions are said to be renewed, or restored by habit; an explanation of which has been already given.

TWENTY-SIXTH, All general actions exhibit a certain revolution, or exacerbation and remission, at particular times or periods. In a state of health, we observe,

that the power or energy of the system is greatest, and the action most perfect, in the morning. In the evening, the action is more imperfect, and the power less, in so much, that, in very weak people, we even find a degree of fever induced. During rest *, the performance of the functions, or the different parts of the natural action, is lessened, and the operations of the mind, which consume much energy by their continuance, are lulled or suspended. There is then a regular revolution, which must take place from the very first day in which we begin to observe regular periods of sleeping and working †; and this, by long continuance,

* Man, in a state of nature, would naturally suspend his operations when the sun set, even although he was not led to do so from fatigue. He works through the day by the light of the sun; and retires, during the darkness of the night, to rest from his labours.

† In the infant, there are no regular periods for retiring

and frequent repetition, comes to be so permanently established, that, even although we remain the whole twenty-four hours without exertion, and in a recumbent posture, we should be sensible of the changes. This revolution, which takes place during health, continues also, by habit, during disease, although no greater exertion be made during the day than during the night; and, hence, we may account for the greater frequency of the pulse, and the exacerbation of many diseases toward the evening. The same observation may also teach us, why we not unfrequently perceive remissions toward the evening, in diseases of an inflammatory nature; because the natural action is naturally less toward night; and, as

to rest; but the child sleeps repeatedly during the twenty-four hours, at no stated intervals. The younger the child, the more sleep is required; that is to say, the less action can it sustain.

the inflammatory action, in healthy people, consists in a morbid increase of the action, we may understand how there should be a diminution of this at night. The pulse, in acute rheumatism, is often quicker through the day than in the evening: But if the inflammation be of a different kind, it may be increased by the same cause which, in acute rheumatism, diminished it. Inflammation of strong parts, in healthy people, is increased by whatever increases the natural action, and vice versa; but inflammation of weakened parts, or in reduced and weak bodies, is diminished by whatever tends to improve and strengthen the natural action. The one disease will be worse, the other better in the day than at night.

THE state of the sun, but particularly the moon, with regard to our planet, likewise affects the human body; and the

way in which it does so has been already mentioned. When the attractive power of the moon operates most, the actions of the system, whilst healthy or diseased, are most excited, that is to say, there is at that time an agent acting in a greater degree upon the body than at another time; and, consequently, the action must, at that time, be greatest. When the attractive power is least, diseased actions are most easily overcome, if all the other causes be alike; but, if other causes interfere, as often happens, this diminution will not be perceived. If this account be true, we shall see why, at certain periods of a lunation, diseases ought to subside most; but every disease, in every person, will not subside equally; for those which have recently commenced, will not be so much diminished as those which have continued longer, and are nearer their natural termination. If, near the end of a

disease, the termination may be hastened by the diminution of the attraction of the moon; if, on the contrary, the disease be increasing, it will be aggravated by the other state of the moon, in which it acts most, and may thus prove fatal sooner than it otherwise would do *. This being the case, I do not see that the doctrine of critical days can be explained by this general principle, which must either be allowed to act equally on all, and produce a crisis in every disease on the same day; or, as I have supposed, must operate differently according to the state of the disease, without any reference to the completion of a regular period, or certain number of days.

* The increased attraction of the moon will operate most visibly on the diseases which are increasing, whilst the effects of diminished attraction will be most perceptible when the disease is declining.

Conclusion.

FROM the whole history of the nervous system, its properties appear to be wonderful indeed, and its delicacy seems to be so great, that we would at first suppose, that it should be perpetually subject to derangement, from the action of even the most trifling cause. But by a more attentive examination, we perceive here, as in other cases, with admiration, the workmanship of an infinitely wise and powerful Creator, who has established such laws in the animal economy, that, in many cases, these hurtful powers operate for their own destruction. When a foreign body is applied to the nose, it is expelled by sneezing: When it gets into the eye, the lachrymal gland, by its sti-

mulus, pours out more tears, and the substance is washed out: When cantharides are applied to the skin, the cuticle becomes elevated, and the source of irritation is removed far from the true skin; or, if it should reach to it, pus is soon formed, and the stimulus is again removed, more disagreeable effects being thus prevented. When a hurtful matter is received into the stomach and bowels, its first operation produces vomiting or purging, and thus causes its own expulsion, as is sometimes seen in over doses of arsenic, or other poisons. When much of the skin is inflamed, the action of the internal parts is diminished, the action of the heart is weakened, and the blood is sent less forcibly to the surface. The inflammation, which would otherwise soon have terminated in mortification, thus more readily admits of resolution. When, on the other hand, the action of the cu-

ticular nerves is weakened, the heart has its action increased, the blood is more powerfully propelled, and the nerves of the surface are soon again stimulated to their proper action. Equal nicety is displayed in the natural actions of the different parts of the animal. When, for instance, the light is faint, the iris opens to admit the most to the retina; but when it is vivid, then the iris contracts, and allows a smaller portion of rays to enter.

THESE properties of the animal evince so much wisdom, that many have been led to imagine, that some intelligent agent presided in the system, and regulated all its actions. This agent has, by some, been believed to be the rational soul, and, by others, a certain preserving power of nature; and, accordingly, the *vis conservatrix naturæ* has, at all times, held an

eminent situation in the schools of physic. But the truth is, that the nervous system is so formed, that these happy effects take place regularly from the immediate action of stimuli, and not by the intermedium or direction of any third power. We are, accordingly, not led up to any visionary archeus, as a source of action; but we are directed to admire the wisdom of the ALMIGHTY FRAMER of man, who established, in his system, the laws by which these operations are produced, when he "breathed the breath of life" into his nostrils.

NOR is this all which we have to admire in the economy of life; for the whole history of it is full of wonder; from the womb even to the grave. The conception of the foetus; its growing from the uterus, like the leaf from the plant; connected to its parent by only a very

slender vessel; its increasing by the nourishment of the mother; and its union with an *immaterial* and *immortal* spirit; are all mysterious, and truly wonderful points; but not more so, than its receiving, after birth, foreign matters into the stomach; its changing their life into its own, and converting them finally into a part of itself; its gradual increase from an imperceptible point to a full grown creature; and its equally slow and regular progress from maturity to dissolution; are topics which are, indeed, worthy to be seriously contemplated by the most exalted mind.

“Fearfully and wonderfully are we
“made.”

DISSERTATION II.

ON

SIMPLE INFLAMMATION,

And its Consequences.

Of the Definition and Division of Inflammation,

By the term inflammation, is generally understood that state of a part, in which it is painful, hotter, redder, and somewhat more turgid, than it naturally is; which topical symptoms, when present to any considerable degree, or when they affect very sensible parts, are attended with fever, or a general diseased action of the system,

THE most obvious division of the action of inflammation, is into that affecting strong and healthy parts, and that affecting those which are weak; and, therefore, the order *inflammatae* will consist of two genera, the *inflammatio valida*, and the *inflammatio debilis*: The specific distinctions will be the same in both of these genera, being founded upon the part affected: The varieties depend upon the duration and activity of the action: That which runs its course rapidly and actively, is called *inflammatio activa*, *sive acuta*; that which continues longer, and seems to have become, in a manner, habitual to the part, is termed *inflammatio passiva*, *sive assuetata*. Some of the species will naturally admit of only the first variety.

It is the *inflammatio valida et acuta* which is here to be considered at greatest

length: The inflammatio debilis will come to be attended to, in examining the causes and treatment of mortification: The little which is necessary to be said concerning the inflammatio assuefacta, will be mentioned in the conclusion of this dissertation.

Of the Stages and Terminations of Inflammation.

In every extensive inflammation, we may always observe two stages, which are marked by different symptoms, those of the one being common to every new action, during its formation, whilst those of the other are peculiar to the disease at present to be considered.

In the first stage, the patient is weak and languid, and complains of coldness;

the pulse is frequent and small; the tongue parched; the head somewhat confused or pained, and the functions of the stomach deranged.

IN the second stage, the pulse becomes harder; the thirst continues; the coldness is succeeded by heat, and the patient becomes restless and uneasy. Whenever these symptoms appear, the local disease manifests itself, and keeps pace with the general affection: The part becomes red, painful, and swelled*, at the same time that its function is impaired.

WHEN this topical affection supervenes, the fever seldom, except in some specific diseases, abates; but, on the contrary, often becomes more violent, and conti-

* The softest parts swell most; those which are harder swell less, with the same degree of inflammation.

nues until the local disease be either removed, or its nature be changed.

When inflammation is suddenly produced by any powerful cause acting locally, we find, that the local affection comes on first, after which the febrile symptoms appear. If, however, the local complaint be slight, and induced by a trifling cause, we do not find, that any general disease is induced, but the affection is entirely topical.

WHEN the fever does not come on until after the establishment of the inflammatory action in a part, it is called symptomatic, being dependent entirely on the local affection: But when the fever precedes the topical inflammation, or is coeval with it, then it is said to be idiopathic, being produced by the direct operation of the same causes which induce

the topical disease. In all cases, perhaps, the fever becomes symptomatic in the end.

WHEN the local inflammation can be removed, without any very remarkable change being induced in the part, it is said to be resolved, or to terminate by resolution; a term which originated from the ancient doctrines on this subject. This is known to have happened, by the diminution at first, and afterwards the complete removal of the different symptoms, whilst the part slowly returns, apparently, to its natural figure, although, most* frequently, there are adhesions formed with the contiguous parts.

* Adhesions are formed in every instance where the inflammation is produced by mechanical injuries; but where it depends upon some general cause, adhesions do not always take place. This is exemplified by rheumatism, where adhesions are not necessarily produced.

When the pain, heat, and redness, disappear, but the part remains hard and swelled, the inflammation is said to end in schirrus. This termination is most frequent in glandular parts.

It, on the contrary, the pain, redness, and heat, continue great for some time, and then abate, the first becoming still more of the pulsatory kind, at the same time that the part remains swelled, but becomes gradually soft and fluctuating, and especially if this change be preceded by chilliness, we may be certain, that the structure of the part is destroyed, and a new secretory action established, producing pus, which fills the cavity formed by the destruction of the inflamed parts. In this case, the inflammation is said to terminate by suppuration: At other times, especially in inflammation of membranous parts, which, in health,

secrete a particular fluid, a liquid, different from pus, and resembling more the natural secretion of the part, is formed. In this, as in the other case, the inflammation diminishes; but the patient has seldom any chills; nor is the structure of the part injured, at least farther than by mere distension, if it be a cavity. The functions of the part are, however, often injured, from the presence of the fluid. This termination, which has been improperly called effusion, is not unfrequent in pulmonic affections, producing hydrothorax. It likewise produces the thick discharge from the nose, in catarrh, and the purulent looking discharge which takes place from the urethra, after the application of acrid matters.

LASTLY, Violent inflammation in a part may kill it, in which case it is said to end in mortification. We are to ap-

prehend this termination, when the inflammation is very violent, compared to the power of the part, and when it manifests no tendency to any of the other terminations. We are still more to dread it, when the colour of the part becomes of a darker hue, and the pulse more frequent and feebler, at the same time that the general strength sinks. In these circumstances, if the disease be not checked by proper remedies, the mortification soon appears: The part becomes first of a purple, and then of a black colour: It loses its heat; the cuticle rises up in blisters, and the part soon becomes soft, putrid, and quite senseless. This termination does not take place without much pain; for although the part, after it mortifies, has no feeling, yet, during the process, the sensation is very acute; and, even after the mortification is complete, the parts in the immediate vicinity are

excessively irritable, being nearly in the same state in which the mortified part was before it died.

WHEN the mortification affected only the cellular substance, it was supposed to be of a milder nature, and was called gangrene; but when it penetrated deeper to the muscles or blood-vessels, it was called a sphacelus.

Of the Exciting Causes of Inflammation.

WHATEVER increases the action of a part, beyond that relation which ought to subsist betwixt the action of a part and its power, is productive of inflammation. The causes which effect this may be divided into two classes; first, those which act directly on the part to which they are applied; second, those

which are not applied to the part which becomes inflamed, but which act indirectly on it.

THE first kind admits of two divisions. First, those foreign agents which operate by what is called their stimulant power, such as cantharides, heat, &c. This operation having been already explained in the preliminary dissertation, it will be unnecessary to make any farther remark on it here. Second, those causes which act mechanically, such as bruises and wounds. Bruises act, I apprehend, in the same way with cold, when it appears to inflame the part to which it is applied; and, therefore, their action will be explained in considering the operation of cold. If wounds be put into a proper situation of uniting, we generally find, that no inflammation takes place; but the structure of the part is directly renew-

ed, by the operation of the same power which nourishes the part in health, and renews its structure when absorbed: But if from any cause this be prevented, then inflammation comes on, from which we may presume, that the prevention of the action of nutrition produces the inflammatory action; for if, by removing the sides of the wound from each other, or by any other cause, we inevitably prevent the natural action of deposition, or nutrition, then the most trifling cause will induce the inflammatory action; even the circumstance of being in an unusual situation, will be sufficient to excite the action to a morbid degree*. On the other hand, the presence of the inflamma-

* Mr. Hunter supposes, that the "stimulus of infection immediately calls forth the action of restoration," which is effected by means of inflammation.

Hunter on Inflammation, p. 190.

tory action, will be sufficient to prevent the action of nutrition, if it should be excited by the operation of the cause which produced the injury; for the wound is often inflicted in such a way, or with such pain, as to increase the action to such a degree as to form inflammation; and this cause will more especially operate, where we interrupt the uniting process, or action of nutrition: It is even often sufficient to cause inflammation, when we use every precaution to forward the uniting process. Cold is very often found to inflame the part to which it is applied; but it has not been deemed easy to give such an explanation of its action as would be applicable to every case. It was, at one time, supposed to operate, by producing stagnation of the blood or humours in the part; but the two opinions which I shall at present

mention are, first, that it acts as a stimulant; second, that it acts as a sedative.

In support of the opinion, that cold is a stimulant, it may be urged, that it produces pain, when applied in too great quantity; that it reddens the skin, and often inflames the part on which it acts; and, finally, that it invigorates the system, when applied in moderation.

It must, however, be evident to every one, that cold lessens the action, either of the whole system, or of a part, according to the mode of its application; and that, if it be long enough continued, it will produce, first, torpor, and then death. This is so fully established, that it is unnecessary to insist upon it; and must prove, that cold is not a stimulant. Pain is produced, both by an increase and diminution of action; and, therefore, we

are not to be surpris'd, that cold should be productive of a very unpleasant sensation or pain. The absence or diminution of any accustomed stimulus, must be productive of pain; and this pain will be violent, in proportion to the extent and continuance of the diminution. The want of food produces, first, slight uneasiness, and then more acute pain; and the same may be said of heat. Whenever any natural and accustomed stimulus is withdrawn, the action of the part is performed irregularly, and becomes imperfect, which is always attended with a disagreeable sensation: But, besides this cause of pain, there is also another, which comes to operate after the cold has been applied for a considerable time, namely, that the action of the neighbouring parts is communicated by sympathy to the cold part, which occasions an action in it greater than the power can sustain, and, conse-

quently, produces a species of inflammation *. There are, likewise, several causes which may be applied at the same time with the cold, and which will tend to excite action, and, consequently, produce pain in the weakened part. Thus, the percussion of the air stimulates and causes pain; hence, rain or snow, drifted in the face, produces much more pain than when it flies more gently, although, in both cases, the temperature be the same.

THAT cold produces redness, is no proof that it is a stimulant; for this redness is, at first, produced by a diminished circulation, the blood remaining longer in the veins; and, therefore, the part becomes of a purple hue, which is very different from the bright red, produced by

* See Prelim. Differt. p. 267.

the direct action of a powerful stimulant.

It may also be said, that cold stops bleeding, and that alcohol does the same, therefore cold is a stimulant; but it is to be remembered, that there exists this material difference, that cold stops active and alcohol passive hemorrhage. Cold has likewise been supposed to be a stimulant, from the invigorating effects of the cold bath; but, in order that cold may invigorate, it is necessary that it be applied for only a short time, and be frequently repeated; it thus, by diminishing the action of the surface, increases that of the internal parts, and thus strengthens. That cold does not inflame, by its stimulant power, will be immediately seen.

THOSE who maintain cold to be a se-

ductive, have been under the necessity of maintaining, that it never inflamed unless some direct stimulant was afterwards applied; or that, by relaxing the vessels, it made them admit more blood, and thus produced a kind of inflammation: But it is to be remembered, that in the living system, blood does neither accumulate in a part, nor is its quantity diminished by any general mechanical cause operating on other parts, or by any affection of the propelling cause, but that the state of the vessels, with regard to blood, depends upon their own condition. Weakness, in any part of the arterial system, ought to diminish the quantity of blood in that part: Weakness, in the venous system, will indeed produce accumulation of blood; but this cannot produce inflammation. Cold, then, cannot act by its relaxing power. Experience likewise proves, that cold may induce inflamma-

tion, without requiring, for this purpose, the subsequent application of heat, or any other artificial stimulus.

COLD may operate on a part, and destroy it in three different ways. First, it may be applied in such a degree, and for such a length of time, as to destroy the vitality of the part directly; in which case, sloughs are formed. Second, it may be applied in a less degree, or for a shorter time; and afterwards a stimulant, such as heat, may be applied, which will excite inflammation. The production of inflammation, by any agent, depends, in a great degree, upon the suddenness of the operation of the agent which excites it; for a quantity of stimulus, which, if suddenly applied, will produce inflammation, may be applied slowly with impunity. From which it will follow, that any given stimulant must more easily pro-

duce inflammation, in a part which has a low action, than in one having a vigorous action, there being a greater disproportion in the one case than in the other, betwixt the action induced by the agent and the previous action of the part. Hence, very slight stimuli will induce inflammation, in parts which have been weakened by cold. Third, it has been already mentioned, that a part sympathises very much with those which are contiguous to it. If a part be weakened, by having its action reduced, and if then the debilitating cause be removed, the action of the part will be increased, or excited, by its sympathy with the neighbouring acting parts: But, as the action ought to be very little, the power being small, it will follow, that disease, or inflammation, must arise from this cause, the action being increased beyond the power. We ought, therefore, in this

case, to diminish the action of the neighbouring parts, in order to prevent their extending their action to a part which is not able to bear it without becoming diseased.

THESE remarks may suffice, with regard to the causes of inflammation which belong to the first class. I come now to consider those of the second kind, or those which operate, not upon the part to which they are applied, but upon distant parts, the chief of which causes is cold.

COLD, applied to the surface of the body, often inflames the internal parts. This has been often observed, and various explanations of it have been attempted; whilst others have denied the existence of the fact.

DR. BROWN supposed, that cold, at no time, produced inflammation of internal parts, unless it were applied to those parts, and had heat applied after it; or, in other words, that cold acted always in one way, and never on any part to which it was not directly applied. He, therefore, classed the lungs amongst the external parts, in order to account for peripneumony being produced by cold. He did not remember, however, that the pain and cough sometimes make their appearance, whilst the patient is still exposed to the cold, and before heat has been allowed to operate. He likewise forgot, that the temperature of the lungs is not affected by the temperature of the surrounding air, being neither warmed by warm air, nor cooled by cold air. The lungs are to be considered as the centre of the circulation, with regard to animal heat, the

heart being only a muscle subservient to them. But, granting that the lungs could be warmed or cooled, it is to be remembered, that a person riding in a cold night, will often have a sore throat, or pain in his breast produced, (if the integuments covering these parts have been exposed), before he alight, and, consequently, before he could be exposed to heat. If this take place in one instance, the theory must be false.

DR. CULLEN supposes, that cold inflames distant parts, by affecting the course of the fluids. When applied to the surface, it inflames the lungs, in his opinion, by obstructing the perspiration, and thus determining to the lungs. Cold is likewise applied, he supposes, to the lungs themselves, at the same time*.

* Cullen's First Lines, &c. Vol. I. par. 345.

Now, were this the case, the lungs ought not to be affected; for if cold were capable of acting on the lungs, it should obstruct the exhalation from them, as well as the perspiration from the skin; therefore, some intermediate point, and not the lungs, would be injured.

THE same idea, although with some modification, is adopted by Mr. Abernethy *, who supposes, that air is thrown out from the blood, along with the matter of perspiration; and, therefore, that when the perspiration is diminished, the determination of fluids to the lungs is particularly to be expected; because, as the air which went off with the perspiration is now retained, it goes to the only other place where it can get out, namely, the lungs, " where the secretion is similar to

* Abernethy's Essays, p. 150.

"the one which has been suppressed;"
 by which suppression the blood has "be-
 come surcharged with air, to which
 the lungs only can afford an outlet."—
 Thus, an accumulation of fluids, in
 the pulmonary vessels, will ensue."

THESE explanations of the action of cold, evidently overlook the action of the nerves, and the true history of diseases; for no "increased determination of fluids" can take place, without increased nervous action. The sympathies of fluids and vessels, were once, indeed, favourite doctrines in the schools; and the trifling and uncertain anastomosis of arteries or veins were anxiously looked for. But the fluids must now be considered as subordinate agents, and the changes and diseases of the living system traced to a higher source than hydraulic principles.

SEEING, then, that none of these opinions give a satisfactory explanation of the manner in which cold, when applied to the surface, inflames the internal parts, we must have recourse to another principle, or to the sympathy of equilibrium, by which, I apprehend, the fact may be sufficiently explained.

COLD, applied, in a moderate degree, to the whole surface, diminishes, for a time, the action of the skin, but raises that of the internal parts, and thus produces strength, if the application be frequently repeated; these parts being the most essential to the animal, and those on which its health and vigour chiefly depend.

THIS effect of cold, in raising or exciting the action of the internal parts, when applied to the surface, is also seen in the benefit which is derived from

dashing cold water on the thighs and legs, in cases of costiveness or suppression of urine, depending on torpor of the intestines or bladder. Upon the same principle, we may account for the occasional bad effects of the cold bath, when applied partially; for, in this case, the parts which are out of the water, may have their action morbidly increased, by the diminution of action in those parts which were immersed. Hence, the popular opinion, that if bathers do not plunge the head under the water, they will have head-ache produced, is not totally without foundation.

If the cold be applied to the surface for a considerable time, or to such a degree as to reduce the temperature of the skin considerably below that which obtained before the application, inflammation is very frequently produced, in some

internal part, owing to the morbid increase of action which is thus produced in it. What part shall suffer thus, will, in a great measure, depend on the portion of the surface which is exposed, each part of the skin sympathizing chiefly with the organs immediately under it. Cold and damp, applied to the feet, are very apt to produce inflammation of the throat.

COLD will most readily produce inflammation, when the surface has had its action previously much increased by heat. When the skin of the throat or breast is very warm, and is suddenly exposed to cold, cynanche or pneumonia is, in nine cases out of ten, produced.

FROM these remarks we may understand, first, how cold applied to the surface, in a certain degree, and for a certain

time, inflames the internal parts; second, how, when it is applied to a greater degree, and continued for a longer time, it inflames the part itself on which it directly acts.

It is observable, that some people are more subject to inflammation than others; and, by examination, we shall find, that these are the most vigorous and plethoric. This condition, from its propensity to inflammation, has been named the phlogistic diathesis. This state is induced by the use of stimulating and highly nourishing diet, invigorating exercise, and the application of cold in such a way as to prove tonic.

INFLAMMATION is readily induced in such people, and is worse borne by them, because, as Mr. Hunter has observed, their action is already as high as it can

possibly be, without causing disease. A very trifling increase, then, which will be easily induced, must be productive of inflammation. Hence, operations are borne worse by healthy people than by those who have been ailing for some time. There is, however, another cause which co-operates with this, and renders operations safer in those who have had local diseases of long continuance, than in those who have met with sudden accidents, namely, that the constitution has been long accustomed to diseased or inflammatory action, and, therefore, is better able to endure the action which is induced by the operation; for morbid actions, which are suddenly excited in a healthy system, are more dangerous than those which come on more slowly. Even if the previous action had not been inflammatory, it was of a morbid nature, and, therefore, should make the action

induced by the operation less dangerous; because we have still only exchanged one diseased action for another, and not excited it in a system formerly healthy.

Of the Proximate Cause of Inflammation.

CONCERNING the proximate cause of inflammation, a very great diversity of opinion has prevailed; but still almost every theory has agreed in admitting the agency of an obstructing cause.

FOR several centuries, the opinions which were held on this subject were very much the same, and received no material change until the discovery of the immortal Harvey.

WHILST the circulation of the blood was unknown, and whilst the hypotheti-

cal notions of the power of the liver, in preparing and sending forth this fluid, continued to prevail, it is not astonishing that the theories of physic should be exceedingly imperfect. So fully persuaded were physicians of the existence and agency of different humours and spirits, and so little did they know of the regular and constant motion of the blood, that they believed in the possibility of depositions and congestions of the blood, the bile, or the lymph; and acknowledged these as the cause of inflammation. Their anatomists taught them, and their professors of physic supported the opinion, that the liver was the centre of the vascular system, from which the blood went forth by day to the extremities, and returned again by night. If, then, any peccant matter irritated the liver, then the blood was sent out more forcibly; and if, at the same time, any part of the body were

weakened, or otherwise disposed to receive a greater quantity of fluid than the rest, then a swelling was produced by the flow of the humours to this place. *Fluxions*, or flows of humour to a place, might happen either by weakness of the part, which allowed the humours to enter more abundantly, or by the place attracting the humours, in consequence of the application of heat, or other agents. When the fluxion was produced, by some irritating cause applied to the source of the blood or humours, and a weakness of the part affected, then the part was said to be passive; but when the fluxion arose from some cause, acting directly on the part, and making it attract the humours, then it was said to be active. The teachers of medicine, then, had two great heads for commenting on; first, the state of the part transmitting; and, second, the condition of the part receiving. The pe-

cular nature of these tumors, depended upon the humour which was sent in the greatest abundance; blood, for instance, produced the true phlegmon; bile produced erysipelas, &c.

It was likewise believed, that, at other times, the part might somehow allow the blood or humours to stagnate slowly in it, from a want of expulsive power; or might detain the fluid, "*quæ in loco affecto gignitur.*" The tumor thus produced, was called a *congestion*, to distinguish it from the one which arose from the sudden flow of humours from a distant part, and which was called a *fluxion* or *defluxion*. The first was formed gradually, without much pain, or the feeling of pulsation, and ran its course slowly; the second appeared suddenly, was very painful, had a pul-

factory feeling, and run its course rapidly.

As the blood was supposed to possess very little motion, and to have its course easily diverted or changed, by very trifling causes; it became an established rule, that, in fluxions, we should endeavour to alter the direction, or "determination," of this fluid. In recent inflammation, they laid it down as a fixed principle, to bleed from some part which was distant from the seat of the disease, by which they imagined, that the current was changed, and a *revulsion* made. If the inflammation was above the liver, which, they said, was the centre of the body, considered medically, they took blood from some part below it; when one side was affected, then they bled from the other. They likewise made a catalogue of the different veins, which

purged the different parts, or detracted from them; and this assisted them in their practice. The cephalic vein evacuated the head; the basilic, the parts farther down; whilst the median detracted from both parts: The left arm evacuated the spleen, and the right one the liver*.

A REVULSION was also effected, by raising a tumor in some other part, by means of ligatures, cupping glasses, &c.; or, by giving nature an opportunity of discharging the humours from distant parts, by applying leeches or blisters to

* The natives of Thibet and Boutan still retain similar sentiments: They bleed in the neck, when they wish to cure pains in the head; the cephalic vein is opened, when the arm or shoulder is injured; the median detracts from the breast or side; the basilic from the belly; and the veins at the ankles from the two inferior extremities. Vide Phil. Transf. Vol. LXXIX.

these: Hence, sinapisms were applied to the feet, in diseases of the superior parts.

If it were not convenient, or if it were not judged proper, to make a complete revulsion, then blood was drawn from the neighbourhood of the parts*, and this was called *derivation*, which differed from revulsion only “in the measure of the distance to which the humour was drawn.” As this, however, was supposed rather to draw more fluid to the part, than to draw from it, most people considered it as dangerous to use derivation in the beginning of the disease.

At the same time that bleeding was used copiously, they also applied repel-

* In inflammation of the throat, for instance, blood was taken from the lingual veins.

lents to the part, in order to co-operate with the other remedies. These consisted of astringents, mixed with an innumerable quantity of inert drugs. If, on the contrary, it was thought improper to repel the matter, then the tumor was to be resolved by "discussion," or a "breathing out of the humour, by insensible transpiration;" and this was effected by applications, which were said to be "hot, subtle, and powerfully penetrating; such as, althes, camomile, "nitre, alkali," &c. This method, however, was generally reprobated, in the commencement of inflammation. When neither of these plans would succeed, then the matter was to be concocted, the tumor suppurated, mundified, deterged, incised, and finally cicatrized.

BLEEDING was directed to be less frequent in the congestion than in the

fluxion; but then the purges were to be stronger, and given with a more liberal hand *. Alongst with the exhibition of purgatives, the hot remedies, called discutients, were to be applied to the part itself; such as, thyme, galbanum, sal ammoniac, &c.

At last, the doctrine of fluxion began to lose ground, and the physicians slowly to perceive, that their boasted theories of derivation and revulsion were absolutely incompatible with the true history of the circulation of the blood. The cause of inflammation was now sought for, more universally, in the part itself, and ob-

* In fluxions, purging was considered as a dubious remedy, at least, where the liver was in fault; because it was thought to draw all the foul and noxious matters to that quarter.

obstruction declared, more decidedly, to be the parent of disease.

It was the opinion of Boerrhave*, that inflammation was caused by an obstruction to the free circulation of the blood, in the minute vessels; and this obstruction, he supposed, might be caused by heat, diarrhoea, too copious flow of urine, and sweat, or whatever could dissipate the thinner parts of the blood, and produce a thickness or viscosity of that fluid. Where this lentor did not exist before the production of inflammation, he imagined, that the larger globules of the blood got into the small vessels, and thus plugged them up. When, for instance, the perspiration was stopped, the fluid being retained, dilated the vessels, and allowed some of these mischievous

* Aph. 375. et seq.

globules to enter, and produce a more permanent obstruction. This circumstance was termed an error loci, and was one of the chief causes assigned for inflammation. But whether the obstruction arose from the viscosity of the blood, or, independently of it, from an error loci, the same effect was supposed to be produced, namely, a resistance to the circulation, which, of course, increased it in the other vessels, proved an irritation to the heart, and increased the force or attrition of the blood, in that part of the vessel which was behind the obstruction; this, again, caused heat and pain, whilst the accumulation of the blood produced redness; which three symptoms are the essence of the disease. But, besides this obstruction, he also brought into account an acrimonious state of the fluids; and, when this occurred, resolution was out of the ques-

tion; nay, if the acrimony were great, gangrene was almost unavoidable*.

THE viscosity of the blood cannot be admitted as the proximate cause of inflammation; because we have no proof that this state ever exists; or, granting that it did, it would not explain the phenomena. In inflammation, the blood, so far from being deranged in the proportion of its component parts, or from one portion having a greater quantity of coagulable lymph (which alone could make it thicker) than another, seems to have its principles more intimately united; for it requires a longer time to separate them by coagulation; and, therefore, no variation can take place, in any particular part of the body. If, then, a viscosity takes place, it must exist equally

in every portion of the blood; and, if so, it must affect every part of the body alike; and, therefore, cannot be supposed to produce only a local disease. But, granting it to be *possible* for viscosity to induce inflammation, it remains to be demonstrated, how this lentor is occasioned, by causes which bring on inflammation suddenly, without affording time for changes of the fluids to take place. It also remains to be proved by experiments, that such a thickened state of the blood ever does exist, either in inflammation, or in any other disease.

WITH regard to the doctrine of error loci, or of red globules going into vessels which did not formerly transmit them, the fact must be admitted, at the same time that the conclusion is denied. When the eye becomes inflamed, the tunica conjunctiva is seen, with its vessels full of

red blood, which, in health, is not the case; but this redness never appears until the inflammation has commenced; it is therefore to be considered as an effect, and not as a cause. Nor does this error loci occasion any obstruction in these vessels; for, if they be divided, the blood flows freely, which shows, that they are large enough to allow of an easy circulation, a circumstance which is altogether incompatible with the notion of obstruction: For, were this obstruction to take place, the flow of blood must be checked; it must either move much more slowly, and, therefore, stimulate less; or, it must take another course; for it is well known, that, whenever a vessel is obstructed by pressure, by adhesion, or by a globule plugging it up, that less blood must go that way, and more by another course; the consequence of which is, that the part will rather be weakened than inflamed.

As for the supposition of the co-operation of an acrimony of the fluids, it may be sufficient to observe, that the proportion of the saline matter of the blood has never been proved to be greater in this than in any other state of the body, and that the very idea of cacochymy is diametrically opposite to the laws of the living system. But enough has been formerly said, in the preliminary dissertation, concerning the humoral pathology; and more will be afterwards adduced. The subject may, therefore, for the present, be dismissed.

PROFESSOR VACCA* was likewise of opinion, that an obstruction to the motion of the blood was the cause of inflammation; but this he attributed, not

* Vacca de Inflam. Morb. &c.

to lentor, or error loci, but to a debility of the inflamed part, which prevented it from propelling the blood as formerly, and produced an accumulation of it in the weakened vessels, the consequence of which, in his opinion, was a species of combustion, or real inflammation. He begins by observing, that there are four principal fluids in the body; the blood, the lymph or serum, the fat, and the nervous fluid. The lymph, being watery, cannot be inflamed or burnt; the blood is slightly inflammable; the fat is altogether so; but the nervous fluid, from its volatility, cannot bear enough of heat to inflame it. It is also laid down as a principle, that no inflammation can take place without the aid and operation of atmospheric air, which both draws inflammable matter to the part, and inflames it. Without fatty, or phlogistic matter, then, and air, no inflammation can take place,

This inflammation is begun by the accumulation of blood, which is to be considered as a heated, or ignited body. The accumulation and "semistagnation" of the blood, uniformly depends upon a weakness of the part, either real or absolute; real, when its power is positively diminished; relative, when it is not diminished, but the strength of the rest of the system preternaturally increased above it*.

IN consequence of this weakness, the blood not only moves more slowly, but more also flows in, which produces a

* "Inflammatio cujusvis partis humani corporis, nunquam fit, nisi in ipsa parte sanguis coaccervetur, et fere quiescat."—"Coaccervatio et semistagnatio sanguinis, vel alius humoris corporis humani, in quacumque ipsius corporis parte minime contingere potest, sine ipsius partis absoluta, vel relativa debilitate." Vacca, p. 18.

swelling of the part. This is farther increased, by the extrication of air from the stagnant matter, in consequence of the heat, by which the part is distended, and still more humour and phlogistic matter is allowed to flow in.

UPON the humoural part of this theory, I deem it to be unnecessary to make any observation ; and, upon the position, that debility of the inflamed part is the cause of inflammation, I think it sufficient to observe, first, that many of the exciting causes evidently have no tendency to weaken, when they induce inflammation : Heat, for instance, frequently inflames before it can possibly be supposed to have produced any weakness. Second, all the symptoms of inflammation evince an increased action. Third, bleeding, and other causes, which diminish action, cure inflammation.

DR. CULLEN considers the proximate cause of inflammation to be "a spasm of the extreme arteries, supporting an increased action in the course of them." This theory, therefore, differs from that of Dr. Boerrhave only in the cause which is assigned for the obstruction. A detection of the fallacy of the one supposition will, therefore, be sufficient to disprove both. But, as Dr. Cullen was a man who formed no opinion without a plausible reason, it will be proper to attend more minutely to his doctrine; and this is very plainly laid down in the two hundred and forty-fourth and two hundred and forty-fifth paragraphs of his *Outlines*. "Some causes of inequality (says he), in the distribution of the blood, may throw an unusual quantity of it upon particular vessels, to which it must necessarily prove a stimulus. But, farther, it is probable, that, to relieve

" the congestion, the vis medicatrix na-
 " tura increases still more the action of
 " these vessels; and which, as in all o-
 " ther febrile diseases, it affects, by the
 " formation of a spasm on their extremi-
 " ties."—" A spasm of the extreme arte-
 " ries, supporting an increased action in
 " the course of them, may, therefore, be
 " considered as the proximate cause of
 " inflammation; at least, in all cases not
 " arising from direct stimuli applied;
 " and, even in this case, the stimuli may
 " be supposed to produce a spasm of the
 " extreme vessels."

THESE paragraphs contain three posi-
 tions; first, that there is, originally, a
 congestion, or accumulation of blood; se-
 condly, that this is removed by the for-
 mation of a spasm; thirdly, that this
 spasm is the work of the vis medicatrix
 naturæ.

UPON the first of these positions, it will be sufficient to remark, that this accumulation of blood is considered as the cause of inflammation, and not as an effect; whereas, it is evident, that it exists only as a symptom. When, for instance, we apply heat, a blister, or any acrid substance, to the surface, the part is stimulated, that is to say, the action of its nerves is increased, which must, consequently, increase the action of its vessels, and, of necessity, the quantity of blood. But, most assuredly, this increased quantity of blood is not the primary cause of inflammation; it is the consequence of an increased action of the blood-vessels, which, again, is merely an effect of the increased nervous action. The first position is, therefore, erroneous; for this accumulation of blood is not an original, or primary cause, but depends upon a disease already induced. At the same

time, it is certain, that this increased quantity of a stimulus must react on the nerve, and augment still farther its action, and, therefore, increase or keep up the inflammation already induced.

THE second position takes for granted that the first is established, and that the congestion is to be removed by the formation of a spasm; or, in other words, that the accumulated quantity of blood is to be propelled, or dismissed, by rendering the extremity of the passage narrower, and the circulation more difficult; which is a contradiction in terms. The obvious effect of this constriction must be, to destroy the free communication of the artery with its returning vein. The blood already in the part must stagnate, and become venous, or it must escape by a retrograde motion, the existence of which, to any extent, is not proved.

Whenever a vessel is constricted, either by a ligature, or any other cause, we uniformly find, that the course of the circulation is altered, more being sent through the branches of the artery coming off above the obstruction; therefore, the part directly supplied by the obliterated or constricted artery must, for a time, be weakened. It may be said, that though the part supplied by the obstructed vessel may be debilitated, yet those parts which, in consequence of this obstruction, must receive more blood, will be inflamed: But we daily find, that, even tying a large vessel, does not of itself produce this disease; how much less, then, will constricting the extremities of a few twigs be capable of affecting it? The uniform effect of obstruction must be, to retard the circulation, and produce torpor, circumstances altogether incompatible with the existence of inflammation, which implies more power-

ful contractions, and a more complete and forcible circulation. Phlegmon is also attended with an effusion into the cellular substance from the extremities of the arteries, a circumstance not easily explained upon the principle of obstructed circulation.

THE third position is, that the formation of the spasm is the work of the *vis medicatrix naturæ*; but, having denied the truth of the former position, it follows, that the present supposition requires no answer; because it is unnecessary to show the absence, or insufficiency of a cause, if the existence of the effect be disproved. Still it may not be improper to remark, that the spasm induced, or the agency of the *vis medicatrix*, is considered as producing the most serious part of the disease. It is not the congestion of blood which is held out as the proximate cause, but the

attempt which the healing, or preserving power of nature makes to get quit of it. The blood is here considered as an exciting cause, but is by no means understood to operate directly; on the contrary, it only gives notice to the preserving power, which, in order to get rid of it, occasions a spasm, followed by disease. Nay, so far does Doctor Cullen carry his theory of spasms, and preserving powers of nature, that he imagines, that even stimulants, operating directly on a part, such as cantharides, mezereon, or red precipitate, induce inflammation, in the same round-about way. But, by a very little attention, we shall find, that all these agents operate primarily on the nerves, increasing their action, and changing it, and, of consequence, the action of the vessels supplied by them. This action, however, is very different indeed from spasm or obstruction.

U u.

THE celebrated John Brown taught a doctrine, which was new to the Edinburgh Professors, and diametrically opposite to the theories which were maintained in their schools. Diseases, according to his system, were all divided into two classes, those which consisted in a morbid degree of strength, and those produced by the varied degrees of weakness. This theory was, to appearance, simple; it was built entirely on the sthenic and asthenic diathesis, and admitted of no intricate actions of the living system. Little labour, then, was demanded of the student, and not much reflection of the practitioners. It was addressed, in a peculiar manner, to the indolent dispositions of mankind, and, therefore, met with considerable success, which perhaps was not a little increased by the plea of persecution.

INFLAMMATION was said, by Dr. Brown, to depend either upon too much strength, or too much weakness. In the first case, the vessels contracted with great force, and pushed on their contents with fury. In the second, the vessels were too weak to carry on the circulation properly, but relaxed freely, to allow as much blood to be pushed into them, as the vis a tergo was able to do. This, however, is by much too mechanical an idea, and cannot be admitted, now that the reasonings of the mathematical physicians have sunk into oblivion. The whole series of symptoms, together with the circumstances which frequently attend the accession of inflammation, as well as its ending in other actions, disprove the supposition. If inflammation depended, in one case, upon too much contractile force of the vessels, and, in another, upon their relaxation, then, in

order to give consistency to the doctrine, it ought to be admitted, that secretions were formed by filtration; and that these states of the vessels, after a certain duration, came to strain through pus. Mere increase of strength, excitement, or contractile power, without a change of action, never can produce the phenomena of inflammation, nor account for adhesion, suppuration, or ulceration. Partial debility of the vessels cannot, on the other hand, produce the second species of inflammation; because this debility should, at the very utmost, produce only a slower circulation, and not an inflammatory action: Neither ought it to be the cause of swelling and turgidity of the arteries, by allowing more than the due quantity of blood to be forced into them; for the quantity of blood in a vessel, does not depend upon the proportion betwixt its contractile power, and

the propelling power of the rest of the system; but upon its own action entirely; otherwise, we should find paralytic limbs always turgid with blood. Farther, the Brownonian theory will not explain the phenomena of inflammation in weakened parts; for here there is a great action, with little power; and hence the part is almost immediately killed. The progress of this is stopped by bark and opium, with proper local applications. From the treatment, then, the Brownonian would say, that the inflammation depended upon weakness. But will simple relaxation explain why death should so rapidly take place?

ACCORDING to Mr. Hunter, "Inflammation is to be considered only as a disturbed state of parts, which requires a new, but salutary mode of action, to restore them to that state,

" wherein a natural mode of action al-
 " lone is necessary. From such a view
 " of the subject, therefore, inflammation,
 " in itself, is not to be considered as a
 " disease, but as a salutary operation;
 " consequent either to some violence, or
 " some disease *."—" The act of inflam-
 " mation is to be considered, as an in-
 " creased action of the vessels †," which
 at first consists simply in " an increase or
 " distension beyond their natural size ‡."
 This increase seems to depend upon a
 diminution of the muscular power of the
 vessels, at the same time that the " elastic
 " power of the artery must be dilated in the
 " same proportion §." This is, therefore;
 " something more than simply a common
 " relaxation; we must suppose it an action

* Hunter on Inflammation, p. 249.

† P. 278.

‡ P. 279.

§ P. 282.

" in the parts, to produce an increase of
 " size, to answer particular purposes;
 " and this I should call an action of di-
 " latation." The whole is to be consider-
 ed, " as a necessary operation of nature*." Owing to this dilatation, there is a greater quantity of blood circulating in the part, " which is according to the com-
 " mon rules of the animal economy; for,
 " whenever a part has more to do, than
 " simply to support itself, the blood is
 " there collected in larger quantity†." The swelling is produced by an extravasation of coagulable lymph, with some serum; but this lymph differs from common lymph, in consequence of passing through inflamed vessels‡. It is this lymph which becomes the uniting medium of inflamed parts; vessels shoot into it; and it has even the power of becoming vascular it-

* P. 282.

† P. 280.

‡ P. 311.

self*. The pain proceeds from spasm†; The redness is produced, either by the arteries being more dilated than the veins, or because the blood is not changed in the veins‡. When a part cannot be restored to health, after injury, by inflammation alone, or by adhesion, then suppuration, as a preparatory step to the formation of granulations, and the consequent restoration of the part, takes place§. The vessels are nearly in the same state as in inflammation; but they are more quiescent, and have acquired a new mode of action||.

INFLAMMATION, according to this, as well some other doctrines, is to be considered, not as a disease, but as a salutary

* P. 309.

† P. 386.

‡ P. 381.

§ P. 371.

|| P. 372.

operation of some wise and provident power, performed in order to rid the system of some impending evil, or to renew a structure, which could not otherwise be restored. But I hold it to be an established point, that there is no supposition more directly contrary to true philosophy, or to the principles which reason teaches, than the opinion, that certain events take place, merely because these events are useful; as, for instance, the coagulation of the blood in mortification *; whether we refer these events to the agency of some peculiar power called nature, or to the more extensive operation of some general principle.

* "For this purpose (coagulation), it (blood) requires rest, either by extravasation, or being retained in the vessels, till the utility of circulating is lost, or till it can answer some good purpose by its coagulation, as in mortification." *Hunter on the Blood, &c.* p. 86.

INFLAMMATION is, in many cases, so far from being a "salutary mode of action," that, in a great majority of instances, it is a most dangerous and a most troublesome disease; and I shall presently endeavour to show, that it is not through the interference of this action, that divided parts unite; but that, on the contrary, whenever the action becomes inflammatory, that then no union and no restoration take place, but the sides remain separate, until the disease subside.

INFLAMMATION is considered as "an increased action of the vessels," which chiefly consists in a greater degree of dilatation, the power of muscular contraction seeming to give way. This allows more blood to enter; which greater quantity of blood is not considered as a symptom or part of the disease, but as

one of the contrivances of nature, the part having more to do than simply to support itself.

How far the loss or diminution of muscular power will account for this dilatation, will afterwards be examined. Here I shall only observe, that the doctrine of the simple increase of action, (circulating action), in a vessel, or simple dilatation, never can explain the production of inflammation, which is to be considered as a state which is new and diseased, and totally different, both in its nature and consequences, from the condition which subsists in health. The other parts of the theory will come afterwards to be considered.

According to Dr. Darwin, when any part is excited "into such violent motion, that a quantity of pleasurable or painful

" sensation is produced, it frequently
 " happens, but not always, that new
 " motions of the affected organ are ge-
 " nerated, in consequence of the pain or
 " pleasure, which are termed inflamma-
 " tion. These new motions are of a
 " peculiar kind, tending to distend the
 " old, and to produce new fibres, and
 " thence to elongate the straight muscles,
 " which serve loco-motion, and to form
 " new vessels, at the extremities or sides
 " of the vascular muscles *." Upon this
 theory I shall only make three observa-
 tions: First, the effect of inflammation,
 or sensation, is considered as its cause:
 Second, we very frequently have highly
 pleasurable sensations, or great pain, ex-
 cited in a part, without any production
 of inflammation; therefore, if the sup-
 posed causes of inflammation have exist-

ed, and no circumstances have occurred capable of counteracting their operation, it will follow, that these causes are not real, but imaginary: Third, the motions which are supposed to take place, are not sufficient to explain the phenomena of the disease.

FROM an attentive examination of the operation of the exciting causes of inflammation, and from a view of its different symptoms, we cannot admit the proximate cause to consist in visciditv, or error loci of the blood, or spasm, or simple increase of sthenic or asthenic diathesis, or actions of dilatation, or increased sensation, but must, upon the principles already laid down, consider it as a new and distinct action of the living system. When this action is uncombined with any other morbid condition, the disease is simple inflammation; but when to this

another action is united, or when the inflammatory action is modified, the disease is no longer simple, but specific inflammation.

In examining new actions, we find it to be of use to compare them with those which they resemble most, and with which we are better acquainted. It has been already mentioned, that whatever tended greatly or suddenly to increase the natural action of a part, changed it, and produced inflammation. This we learn, from examining the exciting causes of this disease; and, by analysis, we find some similarity betwixt this and the natural action.

THE essential symptoms of inflammation, are, redness, swelling, heat, and pain, which, in some instances, are preceded, and, in others, followed, by a

general disease. These symptoms, when taken together, differ very materially from the natural state and condition of the part; and, therefore, although they may have been produced by causes which tend to increase the natural action, yet we must consider this action as materially changed, in consequence of the morbid increase.

ALTHOUGH this be the case, and although many new actions do not admit of analysis, yet the different symptoms of inflammation may be explained, or the action analysed; and this I shall proceed now to do.

Of the Ratio Symptomatum.

REDNESS.—The redness of the inflamed part, is evidently owing to the

presence of a greater quantity of blood than usual; and this augmentation seems to be produced, both by the vessels which formerly conveyed the blood being more distended, and also, by the enlargement of the small vessels, which formerly contained only lymph, but which now receive red blood. It is the enlargement of these small vessels, which have made some suppose, that new vessels were formed by inflammation; a supposition which is evidently contradicted, by observing, that heat, and many other causes of inflammation, operate so quickly, that no new vessel can have time to be formed; and yet the redness is as great, and the inflammation as perfect in a minute, as in an hour or a day, after their application. The formation of a perfect and regularly organised substance, by a strongly diseased action, is

likewise incompatible with the usual laws of the animal economy.

THERE is, likewise, another cause, which will co-operate with this, in producing that bright redness which attends many inflammations, namely, that, owing to the diseased action, the arterial blood is not so thoroughly converted into venous, as in health *. Another consequence of which, as has been formerly mentioned, is, that less life or energy is yielded to the part, and therefore it suffers more than it otherwise would do.

As the vessels are supposed to act more powerfully in inflammation, it has been

* This fact has been mentioned by Mr. Hunter; but he accounts for it upon the principle of its motion being accelerated, which is certainly a mistaken view of the subject. P. 287.

thought, that they ought to contract to a greater degree; and, therefore, ought rather to allow less blood than formerly to enter, than to become turgid. Some have, therefore, supposed, that inflammation was uniformly produced by weakness of the part; and this idea is, in one view, adopted by Mr. Hunter, who supposes, that the muscular power of the vessels is diminished in inflammation, which, therefore, can be more fully dilated. But, certainly, the continuation of the circulation, implies a continuation of the powers which carry it on. Mr. Hunter even allows, that the blood circulates faster than usual, which cannot well happen, if the muscular power gives way. The blood is carried from the heart along all the vessels, first, by the percussive force of the heart, and next, by the contractions of the arteries, which co-operate with the original pro-

jection. Without muscular contraction in every part of the vessels, we must either suppose the heart to possess a force beyond all belief, or we must allow the circulation to proceed only a very little way; for the amplitude of a projected body is always as the square of the impetus. Were the arteries only elastic, they could only react on the blood, and propel it onward, in a degree proportioned to the original action of the heart, and, at every inch, the velocity must become less, because the communicated force must be diminishing. Mr. Hunter, who allows both muscularity and elasticity to the arteries, admits, that the elasticity diminishes with the size, whilst the muscular power increases as the other diminishes. If, then, the muscular coat of the extreme vessels be destroyed or weakened, then the circulation must be stopped, and the part be-

come torpid, instead of inflamed, because there is little or no elasticity to assist the circulation. Mr. Hunter likewise supposes, that, in inflammation, "the elastic power must be dilated;" by which, I suppose, he means the elastic coat. This coat, granting it to exist in the minute vessels, must then, by this dilatation or over-stretching, be deprived of its elastic properties, and, therefore, the circulating power of the artery be still more destroyed.

SOME, who have had recourse to the supposition of weakness producing inflammation, have conjectured, that the power or force of the upper part of the artery was increased, in proportion to the weakness of the extremity; and, therefore, that, by the vis a tergo, the circulation was carried on, and the part likewise became more turgid. But this

goes upon the supposition, that the exciting causes of inflammation can always act more upon parts at a distance, than upon the inflamed part; and reduces the whole nearly to the old doctrine, of a part sending and a part receiving.

It must then be evident, that the muscular power of the artery continues strong and vigorous, and that the contractions are more forcible. The dilatation of the artery is proportioned to the contraction; for, unless in spasmodic diseases, the two properties of a muscle, contraction and dilatation, balance each other*.

* It may perhaps be said, that as muscles, when inflamed, become rigid, so the muscular power of the arteries, in inflammation, ought to be diminished. But it is to be remembered, that the state of the vessels, and the state of the inflamed parts, are not exactly similar, and that the same effects are not produced in each. This must be evi-

SWELLING.—The swelling of an inflamed part may be ascribed to two causes; first, to the increased quantity of blood in the vessels; second, to the deposition of new matter. As the first of these has been already noticed, I shall only here attend to the second.

In every part of the body, there are two sets of vessels, (though many, for particular purposes, have more): The one set secretes the matter which forms the parts, or deposits new organic particles* as the old ones are absorbed; the

dent. In the same way, the state of the vessels in an ulcer, and the state of the ulcer, or the condition of the vessels in any gland, and the state of the gland itself, are distinct in their effects and phenomena.

* By organic particles, I understand matter secreted or deposited in an organised state, so as to repair the waste of the body. By the same term, the Comptes de Buffon un-

other excretes a particular fluid into the interstices, betwixt the different organic particles, in order to preserve the necessary degree of softness and mobility*. Now, it must be evident, that if the action of a part be changed, the functions of the part, and its secretions, must also be more or less affected.

In inflammation, the action is not only increased, but changed; the secretions, therefore, are also changed, and in part increased.

The same cause which affects the derstands molecules, which exist every where in the same form, and do not receive their organisation at the part which they are to join.

* This fluid is even to be found betwixt the particles of bone; but it differs in them from the fluid which softens muscles, and this again from that which belongs to the brain, &c.

THE interstitial fluid (or the fluid which softens the parts) is increased in quantity, but it is also different from what it was in health: It is less perfectly prepared, (if by perfection we mean the state which was originally intended), and approaches nearer to the nature of the lymph or serum. All the secretions are formed from the blood; and, therefore, the less perfectly that they are formed, the nearer must they approach to the nature of the fluid from which they derive their origin.

THE same cause which affects the production of the interstitial fluid, must likewise, in a certain degree, affect the formation of the new or organic particles of the part. These, in inflammation, will be deposited, like the interstitial fluid, in greater quantity, but they will likewise be less perfect; for both the per-

fection and the longevity of the particles depends upon the arteries performing their functions regularly and slowly.

THE swelling, then, depends, first, upon the presence of a greater quantity of blood than usual; secondly, upon the increase and change of the interstitial fluid; and, thirdly, upon the deposition of more organic particles, in an imperfect state*. The second cause operates much more than the other two; for where there is little interstitial fluid, the swelling is less.

MR. HUNTER supposes, that the swelling is chiefly produced by the extravasation of coagulable lymph, which undergoes some changes, by passing through

* Owing to this cause, and to the greater thickness of the interstitial fluid, the part feels hard.

inflamed vessels ; and that this change “ obliges it to coagulate” sooner than it otherwise would do*. But this operation, as he himself acknowledges, should rather retard the coagulation, than accelerate it.

PAIN.—In the preliminary dissertation†, it was mentioned, that every new or imperfect action is productive of sensation in the mind; and it is upon this principle, that we are to account for the pain which attends inflammation. The more violent that the inflammatory action is, compared to the power of the part, or its previous state of action, the more acute is the pain. When inflammation takes place in a part, whose ac-

* Hunter on Inflammation, p. 311.

† Preliminary Dissertation, p. 270.

tion naturally is small, such as cartilages and bones, or whose action, owing to the operation of other causes, ought to be very low, as, for instance, parts which have been weakened by cold, then the pain is very violent. The pain is likewise extremely acute, when parts are inflamed, which, in health, are very sensible *. Hence, inflammation of the intestines is attended with violent pain. In general, the pain, in simple inflammation, is greatest during the diastole of the artery.

* That is to say, parts which have action easily excited in them. Some parts have their action increased slowly, and with difficulty, such as tendons, bones, &c. which may be torn or broken without much pain, until the inflammatory action be slowly induced, and then the sensation is acute. If parts, whose action is naturally low, could have it easily and quickly increased, they would become diseased from very trifling causes; because these would readily induce an action much greater than the natural or previous action of the part.

SOME ascribed the pain to the mechanical cause of distension; but we must ascribe it rather to the peculiar condition of the nerves, or their state of acting; because, otherwise, we should find the pain to be in proportion to the degree of distension, which is not the case. Even the pulsatory feel, which attends inflammation, is not entirely dependent upon simple distension and contraction, but upon the peculiarity of the action; for, in some species of inflammation, that is to say, some modifications of the inflammatory action, this sensation is not produced.

HEAT.—Some have explained the production of animal heat entirely on mechanical or chemical principles, and have too much overlooked the agency of the living principle: But, whatever means may be employed for this purpose, we

must acknowledge them to be entirely dependent on the actions of life. Common matter is capable of existing, without the aid of other matter; but animals and vegetables, which exhibit more varied phenomena, and perform more numerous actions, depend upon other substances for their growth and support, and become afterwards, in their turn, subservient to the necessities of other individuals: They receive their increase from the conversion of other matters into a part of themselves, and have their life renewed, by changing the life of these matters into their own. Heat is likewise a principle, which is necessary to their existence; and this also they derive from without, by processes which depend upon the presence of life. During respiration, the air, which is combined with the blood, and with some of the substances which it contains, gives out part of its

heat to the arterial blood, which unites with it, and from which it is again separated by the action of the living principle, in a quantity proportioned to the degree or extent of the action in general.

THOSE actions which, although different from the natural one, do not rise in degree or violence beyond it, produce little or no increased quantity of heat. Those actions which sink below this medium, produce less heat, and those which rise beyond it, more, than is natural*. The production of heat is not exactly on the same footing with other secretions, which depend not so much on the degree, as on the peculiar nature of the ac-

* By low or violent action, I mean the state of action, or its degree, considered relatively with regard to the power of the part, or to the proportion which ought to subsist betwixt action and energy.

tion; for this being a simple substance, cannot be changed by the change of action, but can only be affected, with regard to quantity, by the degree of action in the vessels *.

THE most current opinion, on this subject, is, that the production of animal heat, depends upon the difference in the capacity of arterial and venous blood, for combining with heat: That, in the extreme vessels, the arterial blood is combined with certain substances, in consequence of which its capacity is diminished, and heat is given out. On the other hand, when venous blood is freed from these substances in the lungs, its capacity is increased, and the heat, which is given out by the decomposition of the air

* It is chiefly at the surface, that the action produces a variation in the degree of actual heat.

which we inspire, is absorbed. But, granting all these facts to be proved, it still must be admitted by every one who reasons on the subject, that these changes cannot take place spontaneously, or of themselves, but must be dependent upon the operations of the nervous energy. It will, then, be nearer the truth, if we consider these changes rather as effects of the general operation which produces heat, than as direct causes upon which this production depends. The generation of heat in an animal, is truly a secretory process, as much as the formation of bile or gastric juice, there being only this difference betwixt them, that, in the one case, a substance is separated from the blood, which formerly existed perfectly in it, and which exists in perfection in every piece of matter, whilst, in the other, the living power produces a new combination, and different arrange-

ment, of the principles of the blood, forming a substance which neither existed in it, nor elsewhere. Neither the one nor the other process depend upon any active changes originating in the blood itself, nor upon chemical principles alone, but both are to be referred, for their production, to the intricate and inexplicable operation of the vital energy. The production of animal heat, then, does not depend directly upon the diminution of the capacity of venous blood for combining with heat, or retaining it, more than the formation of bile depends upon the diminished ability of the blood in the liver, to retain the principles of which it consists.

THE feeling of heat, then, in inflamed parts, will be great or little, according to the capability of the part for pro-

ducing heat, and its capability of receiving the sensation.

From these remarks, we may understand, how a greater quantity of heat is produced by an inflamed part, than that part, without acute inflammation, would produce*. We may also understand, how, in approaching mortification, the heat is little, because the action is low, although it yet be sufficient to kill the weakened part. We can also see, why

* It must be remembered, however, that, although the heat of a part be actually increased in inflammation, yet we are not to judge of the degree by the sensation which is produced; because, owing to the increased sensibility of the part, a given stimulus will produce a greater effect than formerly. Hence, the contact of a foreign body gives pain, and the presence of little more than the usual quantity of heat will give the sensation of burning. We are to judge, then, of the real degree of heat, not by the sensation of the patient, but by the feelings which it produces in another person, when he touches the inflamed part, or by the application of the thermometer.

the inflammatio assuefacta, or what has been called passive inflammation, should produce much less heat, than the inflammatio valida; because the action rises little beyond the natural one, in degree, when compared to the power of the part, and has indeed become almost habitual to it.

THE inflammatory action naturally terminates by a secretion, the nature of which varies in different circumstances. Whenever this takes place, then the heat of the part falls, more or less, from its morbid degree; because, although the action be still unnatural or diseased, yet its violence is less.

EVEN the presence of any secretion, although not dependent on disease, will prevent the heat from being raised so high, by the inflammatory action, as it

otherwise would be * ; one cause of which perhaps is, that the secretion carries off a quantity of heat ; another is, those parts which secrete most fluid, have least capability of producing heat.

We uniformly find, that the inflammatory action of the parts which secrete least, is attended with the production of most heat. The skin secretes less interstitial fluid than other parts ; and, although it sometimes secretes perspiration copiously, yet, in inflammation, this does not take place. It is, therefore, to be considered, with regard to inflammation, as one of the parts which secrete least ; and, on this account, the heat is much greater in inflammation of the skin, than of other parts : But the sensation is not

* Hence, inflammation of the urethra is attended with less heat than inflammation of the skin.

always greater ; for, in enterites, the sensation is very acute, owing to the nature of the part affected, or its sensibility, although the actual increase is perhaps not above one or two degrees more than its natural standard.

ALL increased degrees of the natural action give the sensation of heat, whether more heat be really present or not ; because the effect of heat, or increased action, is produced. The sensation, and the substance which we call heat, are two different things, the one being an effect, the other a cause ; or the one an action, and the other an agent. Now, the same effect may be produced by various causes : Thus, the application of zinc and silver, in a particular manner, to the mouth, will produce the sensation of light, as certainly as light itself. It must, however, be remembered, that,

with respect to the sensation of heat, as well as other sensations, different parts have different susceptibilities. The sensation of touch is peculiarly confined to the cutis, that of hearing to the ear, &c. In the same way, some parts have a greater susceptibility for receiving the sensation called heat, than others. This sensation is strong in the skin and bowels; but, in the brain, muscles, bones, &c. heat produces a somewhat different effect, and gives a sensation of a different nature. This is conformable to what we observe, in other instances, of the effects of foreign agents; for there is no fact better ascertained than this, that agents often produce different effects, when applied to different individuals, or different parts of the same individual. Hence, in simple inflammation of glands, or other parts lying below the skin, with which it does not exhibit immediately the sym-

pathy of affociation, we find, that there is first pain, with little heat, and then more heat, in proportion as the inflammation affects the cutis. As long as there is pain, without much heat, we may conclude, that the inflammation is not making a rapid progress toward supuration; for, unless in some specific inflammations, the surface always becomes affected, before matter is formed in the gland.

FROM these remarks, which are supported by facts, it will appear, that, in inflammation of the surface, the heat is produced in greatest quantity by the cutis, whilst the pain proper to inflammation is seated chiefly in the cellular substance.

ACTUAL heat, in inflammation, is chiefly produced by the cuticular vessels;

and, unless these be affected, the degree of heat is not greatly increased; although, in very delicate parts, the sensation often is *. The sensibility, with regard to heat, of the cellular substance, the muscles, the parenchymatous substance of the lungs and the liver, the substance of tendons, ligaments, brain, &c. is not great; and, therefore, as the inflammatory action in them is not attended with the production of much actual heat, these, when inflamed, give more the sensation of simple pain, than of heat. On the other hand, the pleura, which is more sensible than those parts, with regard to heat, when inflamed, gives both the sensation of sharp pain, and also of moderate heat. The intestines, again, are, in this respect,

* It has been ascertained by Mr. Hunter, that the actual heat of the muscles, or viscera, is very little increased by inflammation.

highly sensible, and, when inflamed, give the sensation of intolerable heat, which is a pathognomonic symptom of enteritis.

It is impossible to account for the variations which take place in the production of heat, by the inflammatory action, upon the mechanical principles which were once maintained, and which still are adopted by some. It was the opinion of Boerhave*, and others †, who wrote after the discovery of the circulation of the blood, that the heat was produced, by the attrition of the red globules, against the sides of the vessels; and the same is embraced by a modern

* Boerhave, Aph. 382.

† Sauvage, Nosologia Method. Tom. I. p. 383.

author*, as one cause of this symptom. But, by the philosophy which is now taught, it appears, that a fluid may flow with the utmost velocity, through a pipe, for a thousand years, without producing a single degree of heat. And our mechanics, regardless of the authority of either Pitcairn or Bell, seem still to believe, that, if they keep their machinery moist, there is very little danger of its being inflamed by the friction.

FEVER.—The last of the primary symptoms of inflammation, is the general fever, or affection of the system, which often attends it. This is sometimes idiopathic; that is to say, it sometimes is produced at the same time with the local inflammation, and by the same causes. At other times, it is symptomatic; that

* Bell's Treatise on Ulcers, p. 28.

is to say, it is produced, not directly by the causes which originally produced the inflammation, but sympathetically by the local inflammation. Both of these species of fever, are, in this disease, produced exactly in the same way, although by different exciting causes; and the manner of their production may be understood, from the principles which are laid down in the preliminary dissertation. The idiopathic fever is always preceded by coldness, because the action is always formed slowly. This coldness is in the commencement real, and afterwards only sensitive. There is at first, owing to the diminution of the natural action, a diminution in the production of heat, and, consequently, a feeling of coldness. This sensation continues for some time after the actual heat, in consequence of the incipient, but imperfect action, begins to be increased, which has been attributed to a derange-

ment in our sensitive faculty : But it may be explained in a different manner ; for, as increased action is productive of the sensation of heat, as well as frequently of the increase of actual heat, in those organs which are peculiarly fitted to secrete it, so imperfect or diminished action is productive of the sensation of cold. During the first formation of an action, there is actual coldness produced ; but, after the action has begun to take place, there is heat produced in a certain quantity ; but, from the imperfection of the action, cold is still felt ; because the same state which cold, or the privation of heat, produces, is present, namely, an imperfect state of action. The sympathetic, or symptomatic fever, sometimes appears to be formed without any coldness ; because, from the violence of the exciting cause, or local inflammation, or the quickness of its operation, it is excit-

ed so quickly, that we do not attend to the symptoms of formation; but these, nevertheless, do take place, although, owing to this cause, their continuance be short. If, however, the local inflammation be more slowly induced, and, consequently, operate more gradually on the system, then the coldness is evidently perceived *. The symptomatic fever, induced by scalding or burning a part, is quickly produced, and we have very little time to attend to the period of formation. On the other hand, the symptomatic fever, induced by wounds, is excited more slowly, and the period of formation is longer.

* Coldness is felt not only in the whole body, if a general action be slowly induced, but it is also felt in a particular part, in local actions, if these be gradually induced. Thus, before eruptions appear on particular parts of the skin, those portions are often felt cold.

THIS fever is not produced by inflammation, if it affects parts only to a slight degree; but it uniformly appears, if the local inflammation be considerable, or, what is the same thing, affects very sensible parts; and, in these cases, the presence of this fever, is a criterion of the presence of inflammation, in parts where we would be led to suspect it, but cannot say decidedly from other symptoms. Thus, if, after lithotomy, the patient complain of pain in the abdomen, we will be led to conclude, that this proceeds from inflammation of the viscera, if it has been preceded by coldness, and accompanied with heat; but if no shivering has taken place, and the pulse be not much affected, it proceeds most probably from a different cause.

THE degree to which this fever will be excited, depends not upon the abso-

lute quantity or violence of the inflammatory action, but, in a great measure, upon the degree of the local inflammatory action, compared to the natural power and action of the part. Those parts whose action is naturally low, and, consequently, whose energy is also small, are extremely painful, when inflamed, and the system sympathises greatly with them, although the real quantity of inflammatory action, considered absolutely, be trifling. Hence, inflammation of tendons, bones, or ligaments, affect the constitution greatly; and, from the same cause, it will appear, that agents which induce violent inflammation in joints, (by which I mean absolutely great inflammatory action), will rapidly produce sloughs of the part, and death to the patient, in no very long time, if it be not subdued. If, on the other hand, the agents have acted less powerfully, then

floughs are not produced, but the system is as much affected, as it would be by a much greater degree of local inflammatory action in some other parts. Those parts, again, which are very sensible, affect the constitution greatly, in the same way, and on the same principle nearly, as those whose action is naturally low; because slight causes induce the same disproportionate action in them; and hence they are soon destroyed. In this way, inflammation of the bowels affects the system greatly, and local mortification is also rapidly produced.

THERE is, however, another cause co-operating with this one, in the present instance, to produce a general sympathy, namely, the natural sympathy which exists betwixt the stomach and intestines; and the rest of the body, by which injuries done to them affect the system

very rapidly; a slight disorder of the stomach, for instance, sometimes producing syncope. This does not depend, as Mr. Hunter * supposes, upon the stomach being the receptacle of, what he calls, simple life; because the existence of such

* "All the parts that may, in one sense, be called vital, do not produce the same effect upon the constitution; and the difference seems to arise from the difference in their connections with the stomach. It is to be observed, that vital parts may be divided into two; one, which is in itself immediately connected with life, as the stomach; the other, where life only depends upon it in its action or use: The heart, lungs, and brain are only to be considered in this last light."—"If the stomach is inflamed, the patient feels an oppression and dejection through all the stages of the inflammation. Simple animal life seems to be hurt or lessened, just as sensation is lessened when the brain is injured."

Hunter on Inflammation, p. 324. 325.

"The stomach is the seat of simple animal life, and thereby the organ of universal sympathy of the material vitz;" P. 402.

a receptacle is contrary to the general nature of the animal economy; and I know of no proofs which establish its existence.

Of the Consequences of Inflammation.

HAVING made these remarks upon the production of the symptoms of inflammation, I shall now proceed to consider its most frequent consequences or terminations, which have generally been said to be, adhesion or resolution, suppuration, and mortification.

ADHESION.—To illustrate the important process of adhesion, or the union of two living parts which have once been divided, it may not be improper to attend to the cause of reproduction in general, or the replacement of those par-

cles which are daily absorbed. Neither absorption nor reproduction can take place in a dead body, but depend entirely on the action of the living principle. If this action be impaired, these functions are imperfectly performed. If, on the other hand, it be too high, then those processes are too rapidly carried on, and the new matter which is deposited, is incompletely organised; its life is likewise less perfect, and its continuance is short. This is illustrated, by what we observe in ulcers and inflamed parts. The new matter, or the organic particles, are furnished entirely by the arteries, and deposited by them, under the direction of the nerves; and the nature and organisation of this matter varies with the action*. These particles are furnished, at

* The action, at the surface, forms skin, and that in the muscle, forms muscle. As long as the actions of the

the moment of their formation, with the specific life of the animal, in a degree proportioned to the perfection of the formation; and their natural longevity observes the same ratio. They live and die from the same causes which influence the life of the body, considered as a whole; but their duration is infinitely shorter than that of the body. They quickly perish, or descend in the scale of existence; they are alternately absorbed and replaced. There is, thus, a continual round of death * and

part remain the same, then a similar matter is furnished; but when the action changes, then the matter also changes. Thus, for instance, bone is sometimes formed in place of membrane, &c.

* Death is the descending of any substance from a higher to a lower species of existence, or from a more perfect to a less perfect vitality; for there can be no such thing as absolute death, that is to say, complete deprivation of a vital principle, until the same Great Power who originally gave existence to matter, be pleased, by his sovereign will, to annihilate it.

reproduction going forward in the animal frame.

In order that this process may go on, or that reproduction may take place, it is necessary, that a void be formed, by the absorption of the old matter; which void is filled up by new particles, which adhere together, and preserve the organisation of the part. If this void, instead of being made slowly by absorption, and being filled up the moment that it is formed, be made suddenly, and of a considerable size, by incision, the same effect is, in the end, produced. The arteries which we cut, pour out their blood, but the quantity is gradually diminished, until it ceases altogether, and a different and more limpid matter drops out. This has been called, by some, the lymph, and by others, the serum, which filtered through the contracting vessels,

But, were this mechanical notion true, then, by varying the degree of pressure, and thus changing the diameter of the vessels, we should, at pleasure, make the discharge either red or limpid. It is more probable, that this is one of the most simple secretions which the blood yields, and that the appearance is regulated by the action of the vessels. If the edges of the wound be laid closely together, we next find, that the divided vessels, which have now become extremities, receive the action which the extremities formerly used to have, when a void was formed by absorption *. They throw out matter nearly the same with that which was formerly yielded, and

* If, however, the void be larger than it ought to be, owing to the sides of the wound not being laid closely together, then this process does not take place, but the part inflames, as has been formerly explained.

the structure of the part is restored. I have said nearly; because, from the attending circumstances, the action cannot be so perfect as formerly; and, therefore, the matter furnished will not be at first exactly the same, and the deviation will be proportioned to the degree in which the action, in consequence of the injury, is increased beyond what it was in health. Hence, in parts where the action was slow in its performance, and small in quantity, the deviation will be most. Thus, when a bone is fractured, the callus is much softer than old bone; it is formed in greater quantity than formerly, and it requires some time before it is formed in the necessary degree of perfection, to enable the person to make use of the bone. But a similar injury done to the skin, or a muscle, will not be attended with the same effects; for the action is there, in health, much quicker and much greater: The de-

viation is, therefore, from the first, trifling, and soon ceases.

SOME have considered the process of adhesion in a more mechanical light, and have supposed, that the lymph was poured out, and glued the parts together, and afforded a bed, into which the vessels from the opposite surfaces might ramify, by which union was produced. This takes place, in the opinion of Mr. Hunter, owing to the vitality of the blood; but I apprehend, that it is fully proved, that whenever blood is extravasated, it loses its animal life, and proves a stimulus to the wound, preventing it from uniting, unless the quantity be very small, in which case it is absorbed, and is thus removed. It is our great care, in surgical operations, to tie the vessels, and clear the surface from blood, in order to procure union, which ought to be attended

with an effect contrary to our wishes, were adhesion to depend upon the uniting medium of the blood. Mr. Hunter likewise supposes, that coagula have the power of becoming vascular of themselves, and thus more firmly uniting the parts; but this is assuredly ascribing the actions of one species of life, and of one body, to that of another: We might as well attribute the actions of the life of a quadruped to the living principle of the polypus.

THE perceptible operations of the life of the blood are very few, and quite distinct from those of an organised animal. If it ever were to perform other actions, and assume an organised form, then it must cease to be blood, and become a substance with which we have no acquaintance; for, hitherto, we know of no substance which can become a part of

an animal, and receive a regular form, except through the intervention of the nerves and vessels, which, by regular gradations, change foreign matters into part of the animal. It has, indeed, been said, that clots of blood have been injected; but, by the same experiment, we might also prove, that a sponge, or a bit of woollen cloth, were also vascular.

ADHESION appears to be a more delicate process, than joining parts with mucus, lymph, or any intermediate substance whatever. It appears to be nothing less than the action of that power, which is always operating in the system, and restoring the waste of the body; but, from the circumstances under which it is exercised, and the causes which tend to make it imperfect, the substance which is thrown out is not always perfectly fi-

imilar to the adjoining parts, at least in extensive wounds.

THIS process, which, when carried on in health, is called nutrition, has, in disease, been named the adhesive inflammation. But the term is improper; for adhesion never takes place, until inflammation subsides; and it often is produced without any previous inflammation, and quite independent of it, without heat, without pain, and without extensive redness. Whenever a wound inflames, its lips separate, and pain is produced: When the inflammation is removed, then the parts adhere, and the pain ceases. Adhesion is, in this case, synonymous with resolution; indeed, resolution is almost always attended with adhesion. There is, however, this difference betwixt them, that adhesion may take place without previous inflammation, whereas

resolution implies the existence of that disease. If, however, inflammation has preceded adhesion, then it is exactly the same with resolution, being a termination of the inflammatory action. He, then, who would talk of the adhesive inflammation, is just as much mistaken, as he who would speak of the resolving inflammation.

IN the natural state of the body, we find skin adhering to cellular substance, and this to muscle, and this again to bone; and the same union takes place in disease, two dissimilar substances often joining together, or adhering; but, for this purpose, it is necessary that both be alive, and that the actions of both be in a proportioned degree.

THESE observations on adhesion, will serve to explain the termination of inflammation, called resolution; and, there-

fore, little more will be required to be said on that subject. Resolution is, by some, said to be merely a cessation of inflammation, the parts returning gradually to their former state, without any intermediate condition. But, if we attend more minutely to the subject, we shall find, that the inflammatory action, like every other new action, uniformly terminates by a secretion. Some actions terminate in new secretions, whilst others only increase the quantity of old ones. When the inflammatory action subsides, we have an increased discharge of the proper secretion of the part, or interstitial fluid, which is also considerably changed in its nature, and becomes thinner than it was during the continuance of the inflammatory action*. The part, there-

* It is owing to this, that, during resolution, the part becomes softer, although the swelling be much the same as formerly.

fore, remains swelled, until this fluid be absorbed; but the swelling is more diffused and œdematous, and, the pain is gone, together with the redness. The organic particles are likewise deposited in greater perfection, and may be said to be a secretory termination of inflammation; because, during the violence of the inflammatory action, they were furnished in a very imperfect state, and were different from what they ought to be. But, when resolution is accomplished, they become again natural, and produce either adhesion, if there has been a division, or a renewal of the proper structure which has been destroyed by the inflammation, rendering the formative or nutritive action imperfect.

SUPPURATION.—If resolution do not take place, owing to the original violence of the inflammatory action, or

from any other cause, then, if the part be not killed, a secretion of a different kind takes place, and the inflammation is said to terminate by suppuration.

CONCERNING the formation, nature, and uses of pus, many opinions have prevailed; but, by much the most universal, is founded on the ancient doctrines of fermentation. By the Grecian physicians, pus was considered as a concoction of the blood or humours, effected by the powers of life, or by nature; and, therefore, the state of ulcers was attended to very much by Hippocrates, in forming his prognosis, as he thus ascertained the degree of vital power, and the extent of the operations of nature. When the blood was effused into the cellular substance, then it was supposed to undergo a species of putrefaction or con-

coction, and to become converted into pus*.

WHEN the component parts of the blood came to be well understood, and when the humoural pathology came to be illustrated by experiments, attempts were made to discover which part of the blood yielded the purulent matter. From some observations on the serum of the blood, Sir John Pringle was led to believe, that pus was formed by a concoction of the serum; for, by exposing this fluid, for some time, to a heat equal to that of the human body, a deposition was formed, bearing some distant resemblance to pus, from which it was considered as allowable to con-

* "Suppurantur autem alterato sanguine ac calefacto,
"donec putrefactus talium ulcerium pus fiat."

Hippoc. de Ulceribus.

clude, that inflammation produced an effusion of serum, and that this serum was by heat converted into pus. This opinion was keenly maintained by Mr. Gaber, who adduced many experiments similar to that just mentioned, in order to prove the doctrine. Upon these authorities, the doctrine of fermentation was adopted by Dr. Cullen, and copied from him by Mr. Bell, neither of whom seem to have remembered, that the productions which are yielded by an animal, either in health or disease, are yielded by processes peculiar to animal life, and which they cannot possibly imitate by any skill, or by the most elaborate concoction. That heat will coagulate a small portion of the serum, and make it furnish a precipitate, is a well-known fact; but it does not thence follow, that it deposits pus. If the mere circumstances of becoming white and thick, were confi-

dered as the only necessary changes which a fluid must undergo, in order to be converted into pus, then the lymph would be a much better subject for experiment-makers to work upon, than the serum. Even the urine itself might be proved to be the source of pus; because Sir John Pringle*, the great authority upon this subject, allows, that this excretion, in health, yields a precipitate entirely the same with that which is furnished by the serum, and which, he supposes, is a redundant portion of the nutritious matter escaping by the kidneys. But a positive proof against this opinion of concoction, is obtained, by considering the situations in which pus is formed; for we find it covering ulcers speedily after they have been wiped clean. Now, had pus been formed from serum, this serum could never have had time to

* Observations, &c. p. 389.

have been digested, and it would have been absorbed by the dressings which were applied. Again, when the lungs become inflamed, in people who have water in the chest, or when enteritis is conjoined with dropfy, we find the inflamed viscera covered with pus; but, unless inflammation has been present, we never find pus in hydrothorax or ascites alone. It must, then, in the cases where we find it, be considered as a secretion produced by inflammation, and not the result of concoction, otherwise we should find it in every case of dropfy.

SOME have supposed, that pus was produced by the dissolution of the inflamed part; but the putrefactive fermentation yields a very different product from pus: Besides, in ulcers, we daily observe an abundant flow of matter, without the smallest loss of substance.

It has been already mentioned, that the inflammatory action changes very much the nature both of the interstitial fluid and organic particles; and these changes may be considered as approximations toward the production of pus, if we consider this as the ultimate secretion which is to be formed. From the continuance and degree of the inflammatory action, the interstitial fluid becomes still more different from what it ought to be, and the organic particles become so imperfect, that they cannot supply the waste of the part, or renew its structure: The form of the part is then destroyed, and the cavity filled with a double secretion*,

* Namely, the new or imperfect substance yielded by the vessels, which formerly deposited organic particles, but especially the changed interstitial fluid: These uniting, form one substance, which is called pus.

called pus *. These observations apply to parts of a simple nature ; that is to say, parts which only form matter, to renew their loss by absorption, and interstitial fluid. But there are other parts, which have a third set of vessels, which are intended to secrete a matter not immediately subservient to the support of the part. When these parts are inflamed to such a degree, as to induce the purulent secretion, then this fluid will also be changed, and form a third component part of pus, as we observe, for in-

* Pus has been considered as a peculiar fluid, of a simple and homogenous nature ; but, from this doctrine, which I apprehend to be true, it will appear to be a compound body, consisting often of more secretions than one, and differing in different organs. The appellation of pus, however, is generally confined to a yellowish bland fluid, of the consistence of cream, which, like other animal secretions, contains a quantity of globules.

stance, in the mammæ, during lactation*, if the true glandular part has suppurated. If, however, the inflammation has been less violent, then the inflamed gland still continues to yield a milky secretion; but the milk yielded by that gland is not the same with that furnished by the rest. At other times, those third set of vessels yield the greatest part of the secretion in inflammation, as we see in the urethra; but, in this case, the inflammatory action is moderate, and the organic particles and interstitial fluid are not much affected; the first of these, at least, forming no part of the discharge, being per-

* If the breasts be not in a secreting state when inflamed, then they are to be considered just as the simple parts above mentioned. They are likewise, even during lactation, to be considered as simple parts, if the cellular substance alone be inflamed, as is frequently the case; for the glandular portion does not always suffer in these cases.

fect enough to remain as constituent parts of the organ.

THIS process takes place, in different species of inflammation, with different degrees of rapidity; and the proportion of the different substances which form pus also varies. In simple inflammation, the quickness of the process depends, in part, upon the nature of the organ affected, but chiefly upon the violence of the action. The component parts, again, depend chiefly upon the nature of the part affected, but also, in part, on the degree of action. When bones inflame and suppurate, which they do slowly, it is chiefly the interstitial fluid, in a changed state, which is furnished, the discharge being thin, and often greasy *. Tendons

* We must distinguish betwixt the fluid which comes from the bone, and that which is furnished by the ulcer of the soft parts which cover it.

yield both the interstitial fluid, and part of the organic particles, but chiefly the fluid which lubricates their surface. Muscles, the brain, parenchymatous substance of the lungs, liver, &c. and cellular substance, yield both interstitial fluid, and organic particles, in the same proportion, in equal degrees of inflammation; and the discharge is little different, to appearance, in these different parts. Lymphatic glands* yield chiefly the interstitial fluid, but also partly the organic matter, and most likely part of the lymph which they transmit. The conglomerate glands yield both the interstitial fluid and organic particles; but the latter, unless in violent inflammation, are in small quantity: They

* Lymphatic glands are, in one view, to be considered as secretory organs; for they undoubtedly give out the lymph in a different state from that in which it entered them; otherwise we can perceive no use for them.

also yield their own peculiar secretion, in an altered state. The testicles, for instance, when they suppurate, give a discharge, which consists of these three substances, but chiefly of the first, next of the last, and in least quantity the organic matter. Along with this is discharged the old substance of the testicles, (which has not been yet absorbed), like threads. Mucous membranes, when they suppurate, yield chiefly their usual discharge, in an altered state, next the interstitial fluid, in a smaller quantity, with scarcely any organic matter, the inflammation being seldom so high as to destroy its organisation.

THE chills which precede extensive suppuration, or suppuration in delicate parts, are to be accounted for upon the general principle already mentioned, of every new action being preceded by

symptoms of weakness during its formation. Mr. Hunter supposes, that the stomach is the great cause of those rigors, in consequence of its being "the seat of simple animal life, and thereby the organ of universal sympathy of the *materia vita*." It is, therefore, affected in all diseases; and the same effect is produced, as if directly injurious causes were applied to itself; which "disagreeable applications" produce coldness: But it surely does not follow, that, because whatever excites squeamishness, induces a temporary feeling of cold, therefore cold is always induced, in disease, by a similar state being excited.

THE coldness which precedes suppuration, is great or little, according to the same causes which influence the degree of the cold fit which precedes inflammation, namely, the extent and degree of

the action, and the delicacy of the part affected. The effect upon the system, of the purulent action, after it is fully formed, is likewise proportioned to these circumstances. Every local action, if extensive or violent, or if it exist in delicate parts, must affect the constitution, and induce a general disease. This is uniformly an affection somewhat similar to the local action, although the symptoms be in a much less degree, and sometimes different. Thus, the local inflammatory action produces pain, heat, redness, and swelling; but the general action produces only heat, slight redness, and uneasiness, partaking rather of the nature of anxiety than pain. In the same way, the purulent action, which is a depraved action of the formative vessels of a part, produces, when it affects the system, an universal affection or derangement of these vessels, or a diseased action

in them, marked by frequency of pulse, and emaciation; the function of nutrition, or the deposition of organic particles, not being properly performed*. It is to this cause, I apprehend, and not to the mere formation of a quantity of fluid, called pus, that we are to attribute the bad effects of extensive suppuration, or ulcerations, or suppurations of the vital parts; for we cannot suppose, that weakness, or hectic fever, is induced, by these abscesses or ulcers acting merely as drains, destroying a certain quantity of blood, or nutritious fluid; otherwise the effect must always be proportioned to the quantity of matter, which is not uniformly the case.

* Hectic fever is never produced, except by such causes as affect the action of nutrition, such as the purulent action, swelling of the mesenteric glands, diabetes, &c.

When matter is formed in a part, it is sometimes removed by absorption: The sides of the abscess are thus allowed to come together, whilst the purulent action abates, and the nutritive one returns, in consequence of which the part is again restored to its proper condition. But, more frequently, the purulent action extends toward the surface; (for all actions tend thither;) which, consequently, has its organisation destroyed, the vessels of the cellular membranes and cutis forming pus; so that, at last, at some particular part where the purulent action has advanced most, the matter comes to be covered only with the cuticle, which soon bursts, and allows the pus to escape; The abscess is then healed, in the same way as in the former instance, and both in the same way nearly as ulcers, which will be immediately illustrated; and, therefore, I shall not ex-

plain here the mode by which abscesses are healed.

It is in consequence of the tendency of all actions to affect the surface, and approach to it, that abscesses spread outward, instead of extending laterally, or inward *. The matter has been supposed to be prevented from spreading through the neighbouring parts, by a coat of coagulated lymph, which lined the abscess; but it rather appears, that the whole of the inflamed part does not suppurate, but that suppuration begins first either about the centre, or rather somewhere

* Mr. Hunter attributes this to absorption, produced by pressure, which acts more upon the external surface, than the sides or bottom, owing to "a readiness in the parts to be freed from a disease already existing." The cellular substance is likewise supposed to be "more susceptible of this irritation" than other parts, and, consequently, is more quickly absorbed.

between the centre and the external surface, leaving a hard portion below, and on every side of it: This gradually grows less; but still the purulent action has reached the surface, before it has affected the lateral margin; and, therefore, there is always a hardened portion surrounding the abscess, until it bursts, and for some time afterwards. But this hardened circle, or stool, as it has been called, is not formed by an effusion of lymph, induced for the purpose of confining the matter, but is the consequence of the whole of the inflamed part not having yet assumed the purulent action.

When a considerable portion of the surface has assumed the purulent action, then the abscess becomes exposed, and an ulcer is said to be formed, which is healed by the same process, which heals an abscess, when it discharges its matter

by a small opening, or when the matter is absorbed; namely, the natural action slowly returns, the purulent one disappearing, and the proper organic particles being again replaced.

The vessels which deposit organic particles, seem to receive their natural action first, throwing out what are called granulations, whilst the vessels which secrete interstitial fluid, are longer of receiving their proper action, and still yield a purulent discharge; but this is not, as must be evident, exactly the same with the pus of abscesses.

EVEN the whole of the vessels which furnish organic particles, do not receive the action at the same time; but one vessel after another seems to lose the purulent action, and deposit proper granulations, which, from the vascularity of

the part, are soft, and of a red colour. These, from the imperfection of the action which forms them, in the beginning of the healing process, die soon, and are quickly absorbed; but they are as speedily reproduced, and every day renders them more perfect, and brings them nearer to their natural longevity. The formative action seems, at first, to balance the absorbing action, and the part remains, to appearance, the same; but, after a little, the granulations are formed faster than they are absorbed; the ulcer is, therefore, filled up, and the excavation obliterated. When the ulcer is filled up to the level of the surrounding parts, or nearly so, we then find the action of increase stop, and the part remain stationary. This depends upon the original laws of the conformation of the system, by which a certain structure is, in every part, produced; and, being once

produced, has a tendency to continue. The granulations are also prevented from rising higher, by the action of the surrounding parts, of a similar nature, each portion of an organ sympathizing with the rest, and having its action regulated, to a certain degree, by that of the rest. It is owing to these causes, that the granulations, in a healthy ulcer, do not shoot beyond the surface, but become covered with skin, the skin-forming action of the neighbouring surface spreading to the ulcer, whenever it becomes nearly level with it; that is to say, whenever it is susceptible of receiving this communication of action. The cicatrizing process begins, first at the margins, both because the depth is originally less there, and, therefore, the granulations sooner rise to the proper level, and also, because they are in the immediate vicinity of the sound skin, and, consequent-

ly, have the action first communicated to them. Sometimes, indeed, the cicatrizing action is assumed by different spots, on the surface, or disk of the ulcer; but, in this case, it is frequently diseased, an unhealthy covering being produced, which soon dies.

THE cicatrix is at first thinner and softer than sound skin, and consists only of one layer, called cutis; but, afterwards, the action becomes more perfect, and both cuticle and rete mucosum are produced. This gradation toward perfection, begins, owing to the communication of action, at the margins; and, therefore, the cicatrix seems to grow less and less, or contract itself, owing to new circles of perfect skin being slowly formed.

WHEN the ulcer is unhealthy, then

this process of healing is interrupted, imperfect granulations are thrown out, and the cicatrizing action is also diseased, a thick insensible substance, called callus, being formed in the stead of thin cutis. The same cause which affects the formation of the granulations, affects also the discharge, which becomes different from what it was in the healthy state, being sometimes thicker, but oftener thinner.

A HEALTHY ulcer is not attended with much pain, but rather with a kind of smarting, part of which, perhaps, may be attributed to the dressings, or other causes, acting mechanically on it; But, when the ulcer becomes unhealthy, from a change in the action, then pain is, in many cases, produced.

SUPPURATION and ulceration are actions complete in themselves, and quite

different from the inflammatory one, being not otherwise connected with it, than as depending upon it originally for their production. Whenever an ulcer assumes the inflammatory action, then the ulcerative action subsides*, and the suppuration lessens†, in a degree proportioned to the violence of the inflammatory action.

The ulcerative action consists of two

* The term ulcerative, does not necessarily imply a continuance of the destruction of parts, or any corroding property, otherwise these remarks would not be just, for inflammation may destroy the substance of the ulcer, and make it larger, by a species of mortification, although the ulcerative action be injured and lessened.

† This has been observed so long ago as the days of Hippocrates, who takes notice of the bad effects which follow from the inflaming of wounds in ulcers: "Igneum enim fervorem hoc inducit, ubi horret et pulsatio accedit." *De Ulceribus*

parts, the granulating and the purulent; The first is a natural action, the last a morbid one; but these two are so connected, as to render it impossible that the one should be rendered unhealthy, without the other also being affected, both conjoined forming a perfect and distinct action, different from the inflammatory one in its nature and consequences, and different also from the suppurative one; for, in this, no granulations are formed, but the vessels which used to deposit them, secrete a fluid, or purulent matter. These actions, although distinct from each other, may yet be converted the one into the other.

THE inflammatory action naturally terminates in the suppurative*; and this may

* The suppurative action belongs to the order Glandulars of the class Mixta.

either continue for some time stationary, and then terminate in the ulcerative, or it may continue to increase. In the first case, the superficial vessels of the abscess, or wound, throw out pus, whilst those immediately below it, retain nearly their natural action, or form organic particles. In the second case, one layer of vessels after another, if I may use the expression, assumes the suppurative action, and the excavation increases, from the loss of power to form organic particles. When the suppurative action terminates in the ulcerative *, then the vessels which used to form organic particles, regain their natural action slowly, and one after another; whilst the other set of vessels, or those which threw out interstitial flu-

* The ulcerative action, when simple, belongs to the order *Ulcerantes* of the class *Mixta*.

id, yield still purulent matter*. If the ulcerative action be perfect and healthy, then the structure of the part is slowly renewed, and the interstitial fluid of the restored part becomes natural; the quantity of pus, therefore, gradually diminishes, its source being lessened.

It, however, from any cause, the ulcerative action should be converted into the suppurative, then granulations are no longer formed, and the part either remains stationary, or the ulcer spreads, according to circumstances.

SIMPLE ulcers, or ulcers where there is no morbid or specific action conjoined with the ulcerative, may be divided into five genera, which consist of several spe-

* It is by the ulcerative action that all abscesses are healed, and that all loss of substance is replaced.

cies and varieties, which will be attended to in considering the cure.

FIRST, The healthy, or healing ulcer, in which the ulcerative action exists in perfection.

SECOND, The indolent ulcer, in which the action is diminished, and, consequently, rendered more or less imperfect.

THIRD, The overacting ulcer, in which either a part, or the whole, of the ulcerative action is increased. This is divisible into two species: First, when only a part of the action is increased; such as the granulating, forming fungus: Second, when the action, considered as a whole, is increased, and carried on with greater quickness; in which case, the granulations are formed very imperfect-

ly, and with very little longevity; the discharge also is changed.

FOURTH, The inflammatory ulcer, in which the ulcerative action is changed into the inflammatory.

FIFTH, The suppurative ulcer, in which the ulcerative action is changed into the suppurative*.

THE symptoms and consequences of these changes will be attended to, when the cure comes to be considered.

* These two last genera cannot properly be called ulcers, if we confine this term to parts possessed of the ulcerative action; but if we adhere to the common acceptation of the word, or consider them merely as solutions of continuity, yielding a purulent discharge, then the division is sufficiently correct.

It has been supposed by some, that ulcers healed rather by the circumjacent parts sinking down to the level of the bottom of the sore, than by the formation of granulations, and the renewal of the lost substance. This doctrine was particularly maintained by M. Fabre, a French surgeon, who supposes, that the depth of an ulcer depends chiefly upon the swelling of the surrounding parts, and very little upon the real loss of substance; and, therefore, that the cure must be accomplished chiefly by the subsiding of the neighbouring parts, which is produced either by amaigrissement or supuration. When the parts have subsided as much as possible, then a cicatrix is formed, which is somewhat hollow, or concave, owing to the loss of substance, which has not been renewed; but this hollow soon disappears, owing to the fattening of the parts below it.

THIS doctrine may, in part, be admitted; for, in many cases, we observe the amaigrissement of the parts very distinctly. In all cases, it may be observed to a certain degree; for, in every instance, a swelling at first accompanies the ulcer; and this often, although not always, makes it appear to be deeper than the real loss of substance would occasion. In extensive ulcers in large members, we also observe, that, by the emaciation of the part, the sides approach nearer together, and the ulcer is healed with less difficulty, than it otherwise would be; and we often find it useful, by proper bandages, to assist this process. But, that granulations are formed, and that they are the chief source of the healing of the ulcer, is a point established beyond all controversy, and which may be ascertained by looking at any ulcer on the tibia.

MR. HUNTER supposes, that the healing of an ulcer is much accelerated, by what he calls the "contraction of the granulations." The edges of the ulcer, he imagines, are brought nearer to each other, by the granulations contracting, like little muscles, the effect of which is increased, by some of the granulations being absorbed; in consequence of which the rest fall closer together. "Besides the contractile power of the granulations, there is also a similar power in the surrounding edge of the inclosing skin, which assists the contraction of the granulations, and is generally more considerable than that of the granulations themselves, drawing the mouth of the wound together, like a purse."

Were granulations to contract them-

selves, by any muscular power, they must certainly have this process instantaneously accelerated, by the application of stimuli, and must exhibit periods of relaxation, which they are not observed to do. Were the contraction of the sore to depend upon any power of the margin to act as a sphincter, we should find, that the same cause ought to make an ulcer consequent to a crucial incision larger, and prevent it from healing so soon, or with so small a cicatrix, as it otherwise would do, which is not observed to occur. Were the contraction to depend upon interstitial absorption allowing the particles to fall nearer each other, or collapse, by the power of gravity, then it must, in its degree and effect, be regulated entirely by the permanent posture of the limb, or situation of the ulcer; for, at one time, it must make the sides fall nearer each other,

and, in opposite circumstances, they must recede; but this, like the former occurrence, we do not observe.

GRANULATIONS, when new-formed, are more vascular, and more luxuriant, than afterwards; and, therefore, when they become more natural, or less spongy, they will occupy less space, and may tend, if the skin be relaxed, to bring the sides nearer together, by their condensation. The granulations, some time after they are produced, both receive less blood, and have less interstitial fluid: The interstices of the sore must, therefore, approach nearer together, and will, by the attractive power of the life which they possess, cohere more firmly together*. They likewise possess a more

* It has been mentioned in the preliminary dissertation, that the life of animals still retains the property termed

perfect life than at first, and, therefore, have a more perfect union. On these accounts, the disk of the ulcer may be lessened, by the approximation of its different particles. The sides may also approach together, in extensive ulcers in large members, by the emaciation of the parts, which lessens the diameter of the limb, and, consequently, allows the skin to cover more of the ulcer.

THE contraction of the superficies, dependent on the operation of these causes, is different in degree, in different in-

attraction, and which belongs to the vital principle of matter, from which it is derived. It was likewise mentioned, that this property seems to be increased, by the elevation into a higher species of life. It is by this property, that the different parts adhere together; and the degree of adhesion depends upon the quantity and perfection of the life, and the proximity of the organic particles to each other.

stances. It is not, however, so great as it appears at first sight to be; because the cicatrix, which is first formed at the margins, is very thin and imperfect; but, in a short time, the action becomes more perfect, and the absorbed matter is replaced with skin more exactly resembling the neighbouring surface. We, therefore, imagine, that the old skin is contracting, or approaching inward, whilst it is in reality the new skin which is becoming similar to the old.

THE ulcerative action, chiefly perhaps in consequence of the purulent one, which makes a part of it, has a tendency to affect the constitution, and induce a general action, called hectic. The symptoms of this disease are, alternate chills and feelings of heat, accompanied by a frequent, small pulse, which is also generally at first sharp; by loss of appe-

tite, thirst, diarrhoea, colliquative sweats through the night, emaciation of the body, with great weakness: The urine is generally pale *. This action is always greatest at the time when the natural action is naturally lowest, namely, in the evening; and these exacerbations are generally preceded by chills; for all actions which are renewed at stated periods, or experience considerable augmentations, exhibit, in a greater or less degree, the symptoms of the period of formation. This action is dangerous, in a degree, or proves fatal with a rapidity, proportioned to the quickness with which it is induced; and hence, when, by any cause, it is speedily produced in people who previously were tolerably healthy, it often proves fatal in the course of a few days. I have known a man die within

* The cheeks are also generally flushed before death,

a week after opening a lumbar abscess, although, at the time of the operation, he was pretty strong.

This disease has been attributed to the absorption of matter from the fores; but, when we consider, that the hectic is not produced by sores, with a certainty proportioned to their size and absorbing surface, but is dependent chiefly upon the nature of the part affected, and the specific qualities of the local action, we will be led to drop this opinion, and will rather ascribe it to an extension of the action, or a general morbid condition, induced sympathetically by it, in the method already mentioned, when treating of suppuration. As a confirmation of this, it is to be remarked, that the degree and continuance of the local action, and the nature of the part affect-

ed by it, have the chief influence in producing the hectic.

THE same causes which regulate the effect of the inflammatory action upon the constitution, regulate also the effect of the ulcerative action. When this action, therefore, takes place in the lungs, heart, stomach, joints, &c. then the hectic is very certainly induced. It is likewise produced by the long continuance of this action, if extensive, in parts which are less delicate, and which do not act quickly upon the system; such as the cellular substance; but it is much more readily induced in the former case, when delicate and vital parts are injured. The peculiar state of the action itself, likewise influences the production of this disease; for healthy ulceration is less apt to occasion hectic, than the diseased or unhealthy ulcerative action, although, in

both cases, the same spot be affected. Hence, scrophulous ulcers affect the constitution more than many others of the same size; and hence also, the influence of the external air in producing hectic, by injuring the ulcerative action. Whenever an agent operates on any part which is not accustomed to its action, or to which it is not to be considered as a natural stimulus, then disease is produced, or the action is changed, unless the power of the agent be very inconsiderable. The air is to be considered as a natural stimulus only to the lungs and surface of the body; and, whenever it operates on any other part, it tends to injure the natural action of that part. When atmospheric air is taken into the stomach or bowels, or is blown into the cellular substance, the action of these parts is slightly injured; when introduced into the blood-vessels, a more serious evil is

frequently induced. But the bad effects of the air is more clearly seen, when the part on which it operates is previously under the influence of a diseased action. The suppurative and ulcerative actions, are merely the formative actions of the part, or its natural action rendered morbid; and these formative actions are naturally carried on without the presence of the air, which would tend to impede them; but it will operate still more visibly and powerfully, in changing the nature of the actions, into which they are transformed by disease, rendering these actions still more imperfect and unhealthy; that is to say, different from the condition which enables them to terminate again in the natural formative actions, by the alteration of which they were produced. When an abscess is opened, and the air thrown in, the discharge becomes thin and copious, and

the healing process is interrupted. When an ulcer of the surface is exposed long to the action of the air, then it becomes foul and unhealthy*. When an abscess of an internal part, or cavity of the body, is opened, or bursts externally, so as to allow the air to come in contact with it, then the constitution becomes affected, the hectic action is ushered in with shiverings, the appetite fails, and, although the health has been previously good, yet the patient often dies in a few days.

THERE are, then, three causes which tend to produce hectic: First, the existence of the suppurative or ulcerative action, in delicate or vital parts; and this

* This change of the ulcer is not so apt to produce hectic, as a similar change of the internal ulcers or abscesses; because the one naturally produces less effect upon the constitution than the other.

+ tends quickly, at least, comparatively speaking, to induce the hectic action. Second, the long continuance of the ulcerative action, to a considerable degree, in less delicate parts; such as the cellular substance, &c.: This acts much more slowly than the other causes. Third, the specific or peculiar qualities of the action; such as scrophulous action, or deviations consequent to the action of the air upon parts where it is to be considered as unnatural. The effect of the qualities will be much increased by the nature of the part affected; for the same causes operating upon ulcers of the surface, will not produce the same effect on the constitution, as when they act on ulcers of internal and vital parts. Hectic will likewise be sooner produced in those who have an irritable habit, than in those who sympathise less quickly and less easily.

THE hectic fever, from whatever cause it may be induced, always exhibits certain symptoms which are essential to it, and which have been already mentioned. But, in addition to these, others may also occur, owing to the peculiarity of the cause; and perhaps no two hectic (induced by different causes) are exactly similar in every circumstance, although the difference may be such as cannot be perceived or detected. There may be, for instance, and undoubtedly is, a difference in the hectic induced by a simple ulcer, from that occasioned by a scrophulous one, or a cancerous one. I have seen the hectic, or diseased formative or nutritive action, accompanied by an emphysema, when it was induced by an abscess, which had an emphysematous action. A man had a seton passed through a tumor on the neck, but very little discharge took place immediately.

In the course of four and twenty hours, the tumor yielded more fluid, which issued alongst with a bubbling of air; at the same time, hectic came on, and air was extricated into every part of the body. He died within two days after being taken ill; and, on opening him, I found air contained in the heart, veins, scrotum, and every cavity of the body, and through the whole cellular substance. The tumor had not the smallest communication with the trachea; and, therefore, neither the local nor general emphysema, could be attributed to the mechanical introduction of atmospheric air. Here, then, was an instance of a peculiar modification of the hectic, owing to the peculiarity of the local action, which could be better observed than many of the less sensible qualities.

MR. HUNTER supposes, that hectic is

a diseased state, induced by an incurable disease, or "a constitution now become affected with a local disease, or "irritation, which the constitution is "conscious of, and of which it cannot "relieve itself, and cannot cure*." But, setting other arguments aside, against this opinion, we find, that, in very irritable people, abscesses sometimes produce hectic, for a week or two, which goes off, when the abscess naturally heals. In consequence of this opinion, Mr. Hunter supposes, that the affection of the constitution, which takes place when a sore, (as, for instance, a compound fracture,) has gone the length of forming granulations, that is to say, begins to cure, is not true hectic, but a disease, which he calls "dissolution," by which he means the state ushering in dissolution. But

* P. 497.

this, I apprehend, from the view which has been given of the subject, will appear often to differ, in no respect, from hectic; only, it proves fatal sooner than this disease, in some other instances, does. At other times, indeed, the fore may induce the state of simple weakness, ushering in death, without hectic; and, in this case, the term "dissolution" may be sufficiently proper.

THERE are, therefore, two states which may be induced by inflammation, and both terminate in death; the hectic state, and the state of simple weakness. The first is illustrated by the effect of ulceration; the second, by the effect of inflammatory fever. It is merely the forerunner of death, and, therefore, will succeed almost every diseased action. But, although it, in most cases, precedes death, yet death does not uni-

versally succeed it; for, as will be immediately mentioned, it may be induced by the sudden cessation of actions, when there is still power to recover by proper assistance.

THE condition of the body immediately before death, is, I believe, generally that of simple weakness, unless when induced by mortification, or similar diseases, as will be presently mentioned. It is, at least, so far a state of simple weakness, that, in most cases, the specific diseases disappear; and, could the patient be restored to strength by any power, he would, in all probability, be free from the peculiar morbid action which formerly existed*.

* This is farther confirmed, by observing, that this state, when it is curable, is cured by such remedies as

This weakness, as Mr. Hunter has observed, may affect one part of the body, or particular functions, less than others. On this account, the circulation is often carried on with more strength, or apparent strength, than is proportioned to the state of the system; and, therefore, death may be nearer at hand than we would imagine.

In the preliminary dissertation, it was mentioned, that all actions which subside suddenly, weaken most. This state may, therefore, be quickly and unexpectedly induced, by such causes, seen or hidden, as produce a sudden diminution of the morbid action. It may, therefore, take place, although the patient be re-

are used against simple weakness, and not by the remedies which we employ against the specific disease which produced it.

coverable; that is to say, although the powers of life be not absolutely exhausted, or worn out.

If long continued and extensive ulceration be productive of injury to the constitution, by exciting a general action, attended with a deviation in the nutritive action, in a manner already explained, so is also, in many instances, the sudden loss or absence of this ulcerative action injurious. If the constitution have been long accustomed to this secretory action, the stoppage or cessation of it is apt to induce, in some other organ, an excretory action, although of a somewhat different kind, at least if there be any tendency to this, on account of age, constitution, &c. Thus, the hemorrhagic action may supervene, upon the cessation of the purulent action, and may affect either the brain, lungs, or stomach, ac-

according to circumstances; or the action of exhalation, into particular cavities, may be produced, giving rise to hydrothorax, ascites, &c. These effects, however, are less apt to be produced, if hectic have been induced by the ulcer before it was healed; because then the general action seems to diminish the tendency of particular parts to be affected. If we amputate on account of a large ulcer, the patient is more apt to become apoplectic, if he has had no considerable degree of hectic, than if this disease has made a greater progress; but, at the same time, if we have allowed it, on the other hand, to go too far, then the system cannot recover, although we remove the exciting cause, but the operation will rather tend to accelerate the death.

THE bad effects of healing old sores, without proper precaution, has been at-

tributed to the stoppage of a quantity of fluid, which produces a redundance, or plethora; and, therefore, "adequate drains," or issues, have been prepared: But, although issues may be proper, in many cases, to prevent, by the continuance of an ulcerative action, the production of a secretory action, in more important parts, yet it does not follow, that issues act by draining off the fluids, as Mr. Bell supposes, nor that the healing of ulcers produces a plethora. If so, we must produce an issue almost as large as the old sore; at least, a small issue will do no good. We might also, by spare diet, abstinence from fluids, bleeding, purging, &c. produce the same effect with an issue, which nobody expects will be the case.

SOME have supposed, that when old sores were healed, a peculiar morbid hu-

mour, which they were wont to discharge, was retained *; but this opinion is now almost abandoned.

MORTIFICATION.——Mortification, strictly speaking, implies nothing more than merely death; but, in its general acceptation, it is made also to comprehend the putrefaction of the part which is killed; for, as the dead portion still adheres to the living, until this process takes place, the putrefactive fermentation has been always considered as synonymous with mortification, and as constituting one of its necessary symptoms. This disease, then, will be induced by whatever can kill the part, whether by subducting directly stimuli necessary for life, or by exciting an action greater than the power of the part can continue

* Morgagni de Sed. et Caus. &c. Epist. LV. a. 13.

to perform. An instance of the first we have in the effects of long continued cold, compression of the arteries, &c. In those cases, the parts being deprived of necessary stimuli, die slowly, and run gradually into the putrefactive fermentation*. This, however, only happens from the subduction of necessary stimuli, when the injuring cause is very powerful, or when some agent excites an action afterwards in the weakened parts; in which case it belongs to the next division, which is illustrated by the effects

* In some rare instances, the part becomes quite dry and hard, constituting what has been called the dry gangrene, to which the epithet white has been added, when the parts preserved their colour. The term gangrene, however, is here improperly applied. I have known one instance, in which the limb became cold, insensible, and quite black, but not dry. It evidently, however, was not gangrenous; because it afterwards recovered its powers, to a certain degree, and lost the black colour, becoming of a yellow tinge.

of lightning, inflammation, or whatever can increase the action beyond what the power is able to sustain.

MORTIFICATION is most likely to succeed to inflammation, in four different circumstances.

FIRST, When the inflammation is very violent and extensive, occurring in parts which were formerly healthy, and not remarkably delicate, possessing naturally a considerable degree of action, as, for instance, the cellular substance, &c. Mortification more rarely takes place in this case.

SECOND, When the inflammatory action occurs to any considerable degree, in parts where the action is naturally little, as, for instance, in tendons, &c.; or where it ought, in consequence

of previous disease, to be little, as, for instance, in parts which have been weakened by cold; or in people who have had fever or palsy, &c.

THIRD, When the inflammatory action affects parts which are naturally very sensible, and very susceptible of having action easily induced in them, such as the intestines, the cutis, &c.

FOURTH, When the inflammatory action is complicated with some other morbid condition, being produced by one of the *agentes dissimiles*, such as pestilential carbuncle, &c. *

* Some gangrenous affections are epidemic, whilst others are endemic. Morgagni mentions from Brunnerus, a particular gangrene of the legs, to which the inhabitants of the Black Forest were subject, and which they were willing to attribute to the use of bad rye. *Epist. LV.* p. 24.

MORTIFICATION may, in one point of view, be compared to the natural process of the dissolution and absorption of the different parts of the body, the organic particles of which enjoy a longer or shorter life, according to the power which they originally received, and the strength and nature of the agents which operate on them. When these particles are, from the very first, weak, a small stimulus must soon destroy the little life which they possess, and their longevity will naturally be shorter, even although no disproportionate action be excited in them. The same law which prevails with regard to these particles, obtains also in the larger portions of the body; for a degree of inflammation, easily sustained by a strong part, will destroy the same part, if it has been previously weakened. The chief difference betwixt these processes is, that, in the one case,

the particles are absorbed, and immediately replaced, whilst, in the other, from the magnitude and degree of the destruction, and the extension of the loss of all vital action, the part cannot be absorbed, but remains, and putrifies *. Both processes likewise resemble each other, in this, that the death is dependent upon an action of the vital principle, which has this for its object. Death has been considered as merely a privation of life, or a cessation of action; but this negative

* When a particle dies in a healthy part, or in an action of a part, then the absorbents change it into a peculiar fluid, by an action of their vital power: But when a great number of particles die at once, in the immediate vicinity of each other, and the absorbents have their action suspended, and begin themselves to die, then the part cannot be absorbed or changed into a fluid, by the vital power of the animal, but it remains, and undergoes the putrefactive fermentation, as will afterwards be mentioned.

state does not constitute absolute death. Death is the descending of the vital principle of one species, to the condition of that of another of a lower degree, and, therefore, must imply activity, or a state of change and conversion, referable to an action of the vital principle itself. There is, however, this intimate connection between a cessation of action, or apparent death, and real or absolute death, that when the vital principle is not employed in some other action, it has a natural tendency to assume the action of descent, or sink down to a lower species. This descent would appear to take place more or less rapidly, according to the absolute quantity of life which exists together, in the organ or part which is to die; for wherever the quantity is very small before the action of descent commences, then it takes place very quickly. Hence, when a number of organic particles are

contained in any portion, and have their life strong, and in due quantity, then they retain it for a considerable time, and descend only very slowly, at the same time that they are absorbed and converted by the living power of the vessels which take them up, into a substance different from their former condition. But if their life be in too small quantity, or only a few insulated particles be taken to act on, then the descent takes place quickly. Hence, if we kill an animal instantly, and cut out a muscle, it will retain its animal life much longer, if the animal be healthy and strong, than if it be weak and diseased. Hence likewise, an animal will putrify soonest, if it die from the action of any of the *agentes dissimiles*, than from other causes; or, in other words, the interval betwixt apparent and real death is shorter. An amputated limb of a strong man

will longer exhibit contraction, by the application of the zinc and silver, than the limb of a man who labours under plague, or cynanche maligna, were amputation to be performed in these diseases; because, in the one case, there is more real animal life remaining, at the time of cessation of evident action, or apparent death, than in the other; and, therefore, the action of descent takes place more slowly, and real death is longer of being produced. This descent may be accelerated, after apparent death, by such causes as tend to destroy still more the remaining vitality, by exciting an action in it, although this action be not attended by contraction, or other mechanical and very evident effects. Electric shocks, heat, putrid matter, tossing about, &c. will hasten this, and induce the putrefactive fermentation, which does not take place in the solid fibre, un-

til the descent be produced; because no
 such extensive chemical changes, and new
 arrangements or combinations, peculiar
 to common matter, can take place, as
 long as animal life remains. But, al-
 though the muscular fibres of the muscle
 will not putrify, until real death take
 place, yet the interstitial fluid, which has
 less life, and, consequently, dies soonest,
 may begin to undergo this process, be-
 fore the fibres, or solid and organised
 part, be dead; but, almost immediately
 afterwards, the whole dies; because pu-
 trid matter tends to destroy animal life;
 and, therefore, the interstitial fluid in
 the muscle hastens the death of the fibre.
 Hence, *ceteris paribus*, the less interstitial
 fluid that a part has, the longer will it live;
 because then one agent, tending quickly
 to excite universal descent of vitality, is
 absent.

We may, from these remarks, understand, first, why a part which dies in consequence of inflammation, should putrify much sooner than the same part, if cut out of the body in health, and kept equally hot; because the quantity of life, before apparent death takes place, is very small: Second, why the mortification tends to spread, even independent of the continuance of its cause, or inflammation; for the putrid matter, which is already generated, tends to excite a fatal action in the surrounding parts, and is to be considered as an *agens dissimilis*. If putrid matter be applied to a wound, that wound never heals without sloughing.

THE bad effects of mortification on the system, are not to be attributed altogether immediately to the original inflammatory action, or to the fever, over-

powering, as it were, the constitution; because we often find these continue much longer, and equally violent, where no mortification takes place, without the same injury being produced. It has been already mentioned, that all local actions have a tendency, sooner or later, to extend themselves, and produce a general disease. The suppurative and ulcerative action produces hectic, in a way which has been formerly explained. In the same way, local mortification tends to induce a general and very dangerous disease, exciting that general state which we find induced by the application of putrid matter to delicate or divided parts, and inducing the tendency to the action of descent, on account of the peculiar nature of the local action*. This

* That the danger arising from mortification is owing to the sympathetic extension of the local action, and not

general disease is also sometimes induced, by the action of an *agens dissimilis*, which operates on the system, at the same time that the local action is produced, and may, in this case, be said to be idiopathic. This is illustrated by *cyanoche maligna*. The induction of this general state, is one great cause of the rapidity with which gangrene sometimes spreads; because, if I may use the expression, it prepares the parts for its reception. It diminishes the quantity of life and of natural action, and tends to induce the action of descent, in every particle. Very slight causes, then, will

to the absorption of putrid matter, and a general "depravation of the fluids," is evident, from this circumstance, amongst many others, that the general action is greater when the local action affects delicate parts, with which the rest of the system sympathises rapidly, than when it affects other parts, although in both cases the absorption may be supposed to be alike.

make a number of particles die at once. Hence, the local action can spread with ease.

THE local action is marked by lividity of the parts, which gradually become black; the cuticle rises up into blisters, and an abominable smell is produced; the mortified part is quite cold and insensible; but the parts which are only assuming the gangrenous state, and which may still be said to be inflamed, are extremely painful, because the action is much greater than the power. }

THE general action is marked by great frequency and feebleness of the pulse, unusual weakness, which rapidly increases; by thirst, squeamishness, foul tongue, and teeth covered with fordes; heavy languid eye, and sharp anxious features. Before death, the urine and stools fre-

quently come away involuntarily, and the patient lies in a kind of comatose slumber. At the same time, the action of descent commences, wherever the life is lowest; and, owing to this, many of the animal excretions become foetid. Sloughs also are formed, where the operation of foreign agents is greatest, as, for instance, where the pressure operates most, as on the shoulders, hips, &c. * Before death, the pulse sometimes becomes full; but then the artery has almost lost its power, and become similar to a vein, with respect to contraction. We feel it rather moving than beating, and it is impracticable to count any regular pulsation. When this happens,

* Tulpia records an instance of universal gangrene, or mortification, which affected the whole body. *Obs. Med. Lib. III. c. 46.* Many similar instances are on record.

it is impossible that recovery should take place*.

It has been supposed, that mortification was produced by some peculiar acrimony of the fluids †, or putrid ferment. Others maintain, that it is produced by the violence of the action of the vessels, which throw out red blood in place of

* In mortification, no one ever recovered from this state; because the action of descent is then very nearly indicated, and the tendency to it is so great now, that, independent of the correspondent weakness, recovery is impossible. But, when this state is induced by some other specific disease, such as fever, it is possible, though barely so, for recovery to take place; for, in this case, the specific disease is most probably gone, and simple weakness alone remains, as has been mentioned, when treating of the prelude to dissolution.

† Vallisera tells us, that the serum, in a case of mortification, was so acrid, that when he tasted it, his tongue smarted for a whole day.

ferum; and that, as this red blood cannot be converted into pus, it putrifies, and causes gangrene*. But these doctrines overlook the peculiar action of the living principle, and attribute to the changes of the fluids, that which really belongs to the operations of life. The generation of putrid matter, has been too often considered as a cause, and not a consequence of disease. The humoural pathology has even been carried so far, that it has been maintained, that the blood itself might, by some causes, become putrid, and thus excite diseases. But if blood be necessary for the continuance of life, what must we think of the theory, which talks of so complete a destruction and change of this fluid, as putrefaction must produce, and yet allows that the patient lives, and supports

* Bell on Ulcers, p. 100.

a diseased state ! That the blood, like the rest of the body, may be reduced to such a state, as to putrify very quickly, after being drawn, or after apparent death, is evident, and will be easily understood, from what has already been said ; but this is very different from a putrefaction of the blood, when circulating in the living body, and a consequent disease.

Of the Modifications of the Inflammatory Action produced by the Nature of the Affected Part.

In the course of this dissertation, it has been mentioned, that, in many instances, the symptoms of inflammation are modified by the state of the part which it attacked. In some, the swelling is greater than in others : Some parts

are much more pained, and some feel much hotter than others.

In the brain, inflammation produces simple pain, without heat, a feeling of tightness and confusion, aggravated during the diastole of the artery. The eyes are red and ferocious, or unsettled, and very sensible with respect to light. These symptoms proceed from the connection betwixt the eye and brain, by means of the short optic nerve. The intellectual senses are impaired, and the power of supporting ourselves in an erect posture is lost. The brain is rendered redder by inflammation, and more turgid. The formation of organic particles is less affected than in many other parts; and, therefore, the intimate structure of the inflamed part is less altered; but still there is a change produced, the matter being tougher, and more like polypus.

The terminations are either resolution, or gangrene, (in which case the portion becomes softer and thinner, and of a more dusky colour, or black, where there are membranes), or suppuration*; in which case, a thick yellow pus is formed, and coma is produced. If this abscess be opened, the patient sometimes recovers, and the ulcerative action commences. The granulations are red, and very vascular, which we learn, by finding them, after death, to be of a dark bloody colour. The pulse is always quickened, and becomes hard; but its condition, with respect to fullness and smallness, is uncertain.

When the eye is inflamed, the vessels

* If suppuration does not take place, either the interstitial or the exhalent fluid is thrown out in greater quantity, and dropsy is produced.

become red and turgid; but the eye itself does not become larger. The sensation is partly that of a foreign body being in it, and partly of heat, or the same uneasy itchy sensation which heat produces, when it acts on the eye. The termination is generally an increased secretion of exhalent fluid;

The inflammation of the tonsil produces swelling, redness, and the sensation of simple pain, with very little heat. If, however, the action has been chiefly confined to the covering of the tonsil, or has been erysipelatous, then there is a sensation of heat and dryness. Any of the terminations may take place here; but that of gangrene is very rare in simple inflammation. When suppuration or ulceration take place, then the quantity of exhalent fluid, which is slightly changed, is increased, and the mouth is

filled with a tough flaver. When the internal part suppurates, or the surface ulcerates, thick yellow pus is formed. Sometimes the superficial vessels throw out a thick yellow substance, like coagulated lymph, (owing to a slight ex-cori-ation), producing specks. The pulse is quickened, but is not in general very hard. Sometimes it seems to be quickened, rather by the simple irritation, or pain, than by the sympathetic fever, and, in this case, it is soft.

INFLAMMATION in the chest produces acute pain, aggravated at each inspiration. The sensation of heat is very moderate. The terminations take place without any peculiarity*. The pulse is hard and full, if the inflammation be moderate; but if it be excessive, or if

* Adhesion is the most frequent termination.

it occur in weak people, the pulse is smaller.

INFLAMMATION of the trachea, urethra, nostril, &c. produces a sensation of smarting, with a slight degree of heat. The natural discharge is increased in quantity, and rendered thicker, and yellow. When this happens, the pain abates. If the inflammation be more violent, then this termination does not take place, but the parts become more turgid and painful; the exhalent fluid, or natural discharge, is either obstructed, or is thrown out, like the interstitial fluid, thick and changed, as in other parts, forming a lining to the canal. If the inflammation be still more violent, then the organic particles also are affected, and become imperfect, or ulceration takes place.

WHEN the stomach is inflamed, the

pain is generally acute, and often of the burning kind; whilst, from the increased sensibility of the stomach, every thing is thrown up. The pulse is small and hard: The anxiety and oppression are great. The termination which is most likely to take place, is gangrene.

INFLAMMATION of the small intestines produces nearly the same symptoms, only the vomiting is not so excessive. The heat is always considerable, and often excruciating, as we observe in those who take arsenic. When the great intestines are inflamed, the heat is commonly less; and, if the inflammation be slight, it is even not at all perceived. The pain, however, is acute, and generally of the lancinating kind. The pulse is frequent and hard, but not so contracted as when the small intestines are affected. The termination most frequently is gangrene,

if resolution be not obtained; but, in some cases, suppuration and ulceration take place, which is seldom, if ever, the case, when the small intestines are inflamed. The intestines may also have their internal surface chiefly affected; in which case, they are similar to the urethra, &c. only the system suffers more. This is productive of a dysenteric affection, or increased discharge of thin slime, and, consequently, is less dangerous than inflammation of the peritoneal covering, or of the whole substance, without this secretion. The same effects are produced in the bladder; for if its internal surface be chiefly affected, then the termination is most commonly an increased discharge of the slime; but if the whole substance be affected, then gangrene or suppuration is produced. The organic particles and interstitial fluid are more affected than in the intestines; for

we find a thickening produced; and within the pores of the thickened substance, there is a gelatinous fluid, which is the changed interstitial fluid.

WHEN bones are inflamed, the nature of the organic particles is changed, and they become much softer: The interstitial fluid is also altered, and resembles thin fat soup. When this flows out, they are said to suppurate. The pain is great.

WHEN cartilages or tendons are inflamed, the pain is likewise great. The part swells, and becomes redder, and more opaque, losing the shining appearance; and the interstitial fluid grows rather thicker. When suppuration takes place, the pain does not abate so much as in some other parts; because the action still is greater than the natural power of the part would produce. Inflam-

inflammation here may also produce sloughs or gangrene.

INFLAMMATION of membranes is also very painful : Their appearance, from the change of the nature of the organic particles, is always altered : They uniformly become thicker and more opaque ; and this structure they often retain, after the inflammation goes off, as we see in the lucid cornea of the eye.

WHEN muscles are inflamed, they swell ; the organic particles are in part affected ; the interstitial fluid becomes thicker, and the power of motion is greatly diminished. The most frequent termination here is a secretion of the interstitial fluid, similar to that in health, but in rather greater quantity *. If,

* When a muscle is inflamed at the time of death, we find the interstices full of a lymphatic interstitial fluid.

however, the inflammation has been more violent, which seldom happens in rheumatism, owing to the diffusion of the action, then the suppurative action is produced, as we observe in wounds &c. The sensation is more of the wringing or pricking kind, than of heat or warmth, although there sometimes be a kind of confused sensation, or resemblance to warmth.

The peculiarities of glandular inflammation, with regard to suppuration, have been already mentioned. They have, in general, a considerable tendency to this termination; and, therefore, it is more difficult to have the inflammation resolved; but the same cause makes it al-

† Wounds likewise act by suddenly producing a void, which, as has been already mentioned, excites the purulent action, even with a very moderate degree of previous inflammation.

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These modifications of simple inflam-

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